DIPARTIMENTO DI SCIENZE SOCIALI
ED ECONOMICHE

SAPIENZA
UNIVERSITÀ DI ROMA

Doctoral dissertation in Theory and Social Research. Doctoral program in Sociology and Applied Social Sciences, cycle XXVIII

TROUBLING BINARY CODES.

STUDYING INFORMATION TECHNOLOGY AT THE INTERSECTION OF SCIENCE AND TECHNOLOGY STUDIES AND FEMINIST TECHNOSCIENCE STUDIES

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Abstract

This dissertation provides a study of Information Technology (IT) as professional and technical culture by drawing together the theoretical lenses of Feminist Technoscience Studies (FTS) and Science and Technology Studies (STS). This central topic has been investigated through an empirical research that focuses on two distinct issues: the gender gap and underrepresentation of women in IT educational and professional paths (computer science, computer engineering, computing); the role of digital artifacts and materiality in the process of organizing within an Italian telecommunication company.

With regard to the first field, I have carried out a historical analysis of the experience of the first female coders in early digital computing era and I have conducted a set of interviews with contemporary Italian female IT professionals and practitioners who form and participate to networks and campaigns that promote women's presence and gender awareness in computing. Drawing on contributions from STS and feminist socio-constructivist approaches in science and technology, I shall argue that the analysis of gender divide in IT should go beyond the issues of female discrimination in order to call into question the gendered nature of computer artifacts and technical knowledge (Faulkner, 2001; Misa, 2010).

In the second field site, I have gone beyond the visible issues of gender asymmetries in organization in order to challenge the alleged neutral character of technical artifacts and materiality (Latour, 1992) by drawing on contributions from STS and Workplace Studies. Starting from this body of knowledge which calls into question the very boundaries between the social and the technical (Heath & Button, 2002), I have employed analytic sensibilities from FTS and the recent debate on new materialism in feminist theory (Barad, 2007; Alaimo & Hekman, 2008; Hekman, 2010; Dolphijn & van der Tuin, 2012) to trace out the agential role of materiality and technical objects in producing marginal and invisible positions (Haraway, 1988; Star, 1991; Star & Bowker, 2007). In this respect, I shall argue that technical knowledge and non-human actors take part in politics and practices of boundary-making, sustaining divisions and hierarchies (Hughes & Lury, 2013).

ACKNOWLEDGEMENTS

As Donna Haraway has poignantly claimed, “nothing comes without its world” (Haraway, 1997, p. 37). In this spirit, this dissertation is the outcome of the intersection of many encounters and events that I could never have imagined at the beginning of my doctoral journey. I am lucky enough to express my gratitude to many people who helped me to shape my research and human growth — many more that can be named here.

First of all, my deepest thanks go to all those who dedicated their time and attention to my inquiries over two years of fieldwork. Without them, this study would not have been possible. This includes the many women IT professionals and students I came across all over Italy as well as all the men and women working at Passic TV. While they remain anonymous in this venue, I am particularly grateful to Andrea Meloni whose constant presence and support helped me to navigate an important part of my empirical research.

I am (and always will be) hugely grateful to my advisor, Assunta Viteritti, for her support, her presence, and friendship. She challenged my thinking about doing research and pushed me to go beyond traditional disciplinary boundaries. At the same time, she always trusted my ideas and encouraged me to pursue my own interests and aspirations. Assunta also taught me that academic work has interesting connections with personal life, so that “everything is a process”: I will try not to forget this. Thank you, Assunta.

I am grateful to Prof. Guglielmo Chiodi — director of the PhD Program in Sociology and Applied Social Sciences at Sapienza from 2012 to 2015 — for his attention towards young researchers and for his constant encouragement to approach foreign academic environments.

The outset of this research almost coincided with the attendance at my first STS Italia International Summer School held in the gorgeous landscape of Ostuni, Puglia. During those days I had my first systematic encounter with STS scholarship

and the great people who form the STS Italia academic community. Throughout my PhD, I had the chance to appreciate their intellectual work and practical commitment to giving visibility to STS in Italy, attracting Italian and international scholars as well as young researchers, and challenging the current production and circulation of knowledge in Italian academic settings. Here, I would like to name and thank some of them for these efforts: Attila Bruni, Claudio Coletta, Paolo Magaudda, Giuseppina Pellegrino, Manuela Perrotta, Assunta Viteritti, and Paolo Volontè.

During my doctoral work, I spent six months as visiting PhD researcher at Cornell University, working jointly with the department of Information Science and the department of Science and Technology Studies. In this respect, I am deeply grateful to Trevor Pinch who made this experience possible. Throughout my stay at Cornell, I have been fortunate to work with Trevor and be impressed by his commitment to promoting the work of young STS researchers. Also, I have learned from him, and from all the people I met at Cornell, that doing serious work does not need to be at odds with having fun. Additionally, my research and academic training in STS benefited tremendously from the courses I attended and the compelling discussions I had with other graduate students and teachers. So, thanks to Michael Lynch, Malte Ziewitz and Ronald Kline for having welcomed me in their classes. I am also grateful to Steven Jackson, who kindly agreed to house me in the department of Information Science. Finally, thanks to the wonderful people who made me feel like home during my stay in Ithaca: Samir Passi, Ranjit Singh, Alana Staiti, Shion Guha and Jessica Polk among others.

During the last year of my doctoral program, I took part to a broad research project funded by Sapienza University on female trajectories in technoscientific fields. Such experience has further increased my intellectual and human growth especially because of the people whom I worked with. So, many thanks to Rossella Costa, Luisa De Vita, Orazio Giancola, and Alessia Pozzi.

Also, a very warm thanks to my friend and colleague Enrico Gandolfi for the work and life we share.

Finally, I wish to thank my family for their love and constant support. Their sense of care and discretion are fundamental goals and sources which I keep drawing on.

During the writing of this thesis, the life (along with many others) of two young Italian PhD researchers was tragically taken away by senseless acts of terror and violence in Paris and Cairo. These pages are dedicated to the memory of Valeria Solesin and Giulio Regeni.

Roma, May 2016

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PREFACE

This dissertation concerns the study of Information Technology (IT) as professional and technical culture through the theoretical lenses of gender and feminist studies of science and technology and science and technology studies. I have addressed this topic through the empirical engagement with two field sites: interviews with women professionals who work in computing and give shape to networks and initiatives that promote female presence and gender awareness in computing; an ethnographic study in an Italian telecommunication company that calls into question specifically the role of digital artifacts and materiality in the process of organizing.

The discourse I unroll in these pages is divided into *three main parts*. *Part One* presents the theoretical and methodological issues related to the central topic of the research. Accordingly, it unravels the theoretical underpinnings that sustain the analysis — which are Feminist Technoscience Studies (FTS), Science and Technology Studies (STS), and workplace studies — with particular regard to the role of feminist critique in engaging sociological studies of science and technology. Additionally, this section illustrates the empirical settings wherein I have carried out my research and undertakes a critical and feminist-informed discussion on the performative character of methods (Law & Urry, 2004; Lykke, 2010) in shaping research interests, subjects and objects at stake in research projects.

Part Two conveys the analysis of the first empirical site, that is the investigation of women and gender issues in computing, whereas in *Part Three* I account for the organizational ethnography.

Such plan of the work reflects my path of engagement with the literature and the consequent analytic sensibilities I have mobilized in order to put my inquiries at work in the fieldwork. More specifically, the three main parts through which this dissertation is organized should be understood as a progression toward greater complexity with regard to both analytic inquiries and empirical research. To phrase this progression differently, it could be said the analysis moves from the visible issues related to the gender gap in computing toward the invisible implications of the agency of technical artifacts and materiality in terms of gender divide, where 'gender' here is to be understood as power differentials, marginal positions and invisibility that the inquiry of a digital artifact and materiality has brought to light.

Following this line of reasoning, the first analytic inquiry concerns the problem of gender gap and the shortage of women in computing and joins a growing and diverse body of research (Cozza 2007; Lagesen, 2007; Misa, 2010; Ensmenger, 2010; Abbate, 2012; Corneliussen, 2014) that explore the gendered shaping of computing by examining the experiences of women working and studying in IT fields. I have faced such issues by drawing on statistical data, historical analysis and interviews with Italian female professionals who openly engage such visible problem with their participation to networks and campaigns that aim at recruiting young women in IT and promoting gender awareness in IT fields.

With the second analytic inquiry I have employed some approaches in the feminist critique of science and technology (Haraway, 1988; 1997; Star, 1991; Barad, 2003; 2007; Suchman, 2007) to detect things absent, invisible, silent

generated by technology and technical knowledge in action. Thus, this second line of research does not aim at just taking into account the already evident power differentials between men and women in IT, but it problematizes the supposed neutral and passive character of mundane artifacts and materiality (Latour, 1992), arguing that they take part in politics and practices of boundary-making, thus sustaining divisions and hierarchies (Hughes & Lury, 2013).

PART ONE

Information Technology, Science and Technology Studies and Feminist Technoscience Studies: theoretical and methodological issues

1. OVERVIEW OF THE THESIS

1.1 Central topics: examining information technology through feminist theory of science and technology

This dissertation examines information technology as professional and technical culture through the analytic lens of Science and Technology Studies (STS) and Feminist Technoscience Studies (FTS). The study addresses such overarching concern through the engagement with two different empirical settings: the study of networks and initiatives that promote female presence and gender awareness in computing, and an ethnography within a telecommunication company. In undertaking such research, I have drawn theoretical and analytic resources from a range of interdisciplinary fields such as FTS, STS, and workplace studies, which I have sought to put in conversation to one another.

In this respect, my engagement with two different field sites has unfolded the importance of employing different analytic devices in order to make visible what is apparently invisible on the one hand, and to problematize what, at first glance, appear as self-explanatory demands. More specifically, I have sought to trace some issues pinpointed by feminist approaches in science and technology such as claims

and demands in terms of gender power relations and equal opportunities by exploring the relationship between women and computing; on the other hand I have questioned the material infrastructure that supports and enables the cooperative work in a tech company in order to unveil other feminist concerns in technoscience — such as how to enact silence (Star & Bowker, 2007), give voice and representation to the traditionally invisible (Star, 1995), interrogate boundaries (Suchman, 2007), highlight local and marginal positions (Haraway, 1988; Braidotti, 1994). In doing so, I have tried to bring feminist STS sensibilities into workplace studies and, conversely, to emphasize the role of materiality and technology in what appears as just a matter of equal opportunities in IT.

In its entirety, this dissertation is guided by the acknowledgement of the performative character of social inquiry and methods (Law & Urry, 2004), a concern that Annemarie Mol (1999) has phrased as *ontological multiplicity*, namely the argument by which reality is done and enacted through specific material-semiotic practices rather than simply observed. Such an understanding of social research is close to what John Law (2009) has defined as 'interference', namely the act of making differences by means of descriptions and knowing practices. According to Law, feminist STS contributions, such the seminal work of Donna Haraway, have challenged the absence of politics in mainstream STS — such as Sociology of Scientific Knowledge (SSK) and Actor-Network Theory (ANT) — by showing the extent to which making knowledge means making difference, that is interfering with the object of the study. In this respect, it is important to say that the normative character of such knowledge practices does not lie in the development of general

rules or classificatory schemes to distinguish the good from the bad; rather, in the words of Law, they offer "powerful but specific and situated tools for working in and upon particular analytical and political problems in order to know these better and to move them on" (Law, 2009, p. 9).

1.2 Theoretical underpinnings

As suggested in the previous sections, a variety of analytical sensibilities inform this study. Such heterogeneous body of knowledge pursues two fundamental aims: on a theoretical level, I aspire to cultivate a dialogue among STS, FTS and workplace studies in order to underline how analytically beneficial they can be to one another; on the empirical level, I draw on such interdisciplinary scholarship (STS, FTS and workplace studies) in order to navigate two field sites that present different characteristics and concerns, thus demand different analytic insights. After all, interdisciplinarity is a common reference to all these fields of inquiry insofar as they are widely presented and performed as such (see Barry & Born, 2013).

STS, for example, set out as an "interdisciplinary adventure" as David Edge claimed in recalling the early days of the Science Studies Unit at Edinburgh University (Edge, 1995, p. 3). Over the years, this field of study has become widely known and diversified for gathering contributions from history of science and scientific controversies, cultural anthropology, sociology, economics, law, communication, information science. As Peter Dear and Sheila Jasanoff (2010) point out, STS embraces the investigation of knowledge and knowledge making practices, the ways whereby they become authoritative knowledge and are embodied in

objects and material systems, to examine the role they play in all forms of social life. Such an intellectual endeavor cannot help but promoting collaboration among disciplines, methodological tools, and empirical resources, thus it is inherently interdisciplinary. Given its diverse genealogies, STS are also indicated through terms such as 'science, technology, and society', 'social studies of science and technology', 'sociology of science and technology', 'science studies', 'technology studies'. In these pages, they are used as synonyms.

The body of knowledge called 'feminist technoscience studies' (FTS) has been defined as a "trandisciplinary field" (Åsberg & Lykke, 2010) as it merges social studies of science and technology and the multiple critical intellectual legacies of feminist critique (Brown, Cartwright, Lampland, Lee, Mills, Murphy, Myers, Roy, Serlin, Subramaniam, Wilson, 2015). In this respect, FTS is here regarded as a "nodal point" (Lykke, 2011), that is a discursive site that has historically gathered a plurality of epistemological and political traditions. These are concerned with various issues such as the analysis of disparities between men and women in science and technology, the inequities of technoscientific systems as for the discriminations of women, queer persons, people with disability and illness, elders, people of color. On the other hand, FTS examines how science and technology, in their plural forms (artifacts, places, infrastructures, standards, protocols, policies), are constructed through and entangled with sexist, gendered, and political scripts. This strand of research is often (including here) referred to by other names such as 'feminist science studies', feminist cultural studies of science', 'feminist studies of science and technology, 'gender and science' and 'gender and technology'.

The research strand known as ‘workplace studies’ (Heath & Button, 2002) focuses on work, technology and interaction in organizational environments. This area of study challenges traditional approaches to organization studies that are primarily concerned with the social organization of work, and invites to put into question the very boundaries between the social and the technical. In this respect, the influences of STS are clear insofar as it challenges the deterministic approach that sociology of technology has long adopted (Pinch & Bijker, 1984), and argue that also non-humans have agency (Callon, 1984; Latour, 2005).

STS, FTS, and workplace studies constitute the main overarching theoretical resources I draw upon to develop my inquiries. Further crucial conceptual tools — such as ‘practice’, ‘affordance’, ‘sociomateriality’ — inform them and shall be employed and discussed along the analysis.

1.3 Keywords: Feminism, gender, women, information technology, computing

“The fact is, they just don’t speak the same language”. This expression, quite frequent in the common language, is reported by Raymond Williams in the introduction of his cultural history of British society, when he describes a conversation he himself had with a man he had worked with during the World War II when they both were in the British Army. In talking about the differences between the world before the war and the new world, they both came out with the same conclusion: “the fact is, they just don’t speak the same language” (Williams, 1983 [1976], p. 11).

Such common phrase is helpful to discuss important issues that difficult words — such as 'culture', 'family', 'class', 'materialism', 'history' — pose for sociological analysis. Indeed, far from bringing just a problem of "proper meaning" to define, the emergence and usage of keywords involve two types of problems: the need to pinpoint clear meanings; and the explicit and implicit connections that people make with particular formations of meaning, which, Williams suggests, are ways not only of discussing, but, at another level, of *seeing* many of our central experiences. These different associations between meanings and experiences are indeed embedded in those words that convey ideas, beliefs, and values, rather than just (more or less) correct definitions. In Williams' words:

> Then when we go beyond these to the historical dictionaries, and to essays in historical and contemporary semantics, we are quite beyond the range of the 'proper meaning'. We find a history and complexity of meanings; conscious changes, or consciously different uses; innovation, obsolescence, specialization, extension, overlap, transfer; or changes which are masked by a nominal continuity so that words which seem to have been there for centuries, with continuous general meanings, have come in fact to express radically different or radically variable, yet sometimes hardly noticed, meanings and implications of meaning. (Williams, 1983, p. 17).

The problem of meaning construction as described by Williams deeply affects the main keywords that make up this dissertation: feminism, gender, women, information technology, computing. To reconstruct a genealogy of them is out of the scope of this work since this task would deserve an entire study on its own. Rather, I wish to clarify some overarching meanings and uses that appear in these pages as they emerge from the literature I have drawn upon as well as from the

empirical sites I have explored. In doing so, I aim to reduce as much as possible the degree of ambiguity and the risks of misunderstanding that these keywords inevitably present.

The word 'feminism' (and its qualifier 'feminist') refers here to the analytical perspective of 'feminist teschnoscience studies' (FTS) introduced in the previous paragraph. Since it presents a direct connection with the words 'gender' and 'women', it is important to clarify that they do not coincide with one another. The reference to feminist critique in science and technology pertains to those epistemologies that have provided a radical critique of technoscience by questioning practices, values, assumptions and power relations behind the production of knowledge. In the word of Sandra Harding, this analytical move can be phrased as from the "women question in science" to the "science question in feminism" (Harding, 1986, p. 29). This feminist criticism has provided important concepts and guiding tensions such as 'situated knowledge', 'strong objectivity', 'intra-activity', 'diffraction', 'agential realism', 'onto-epistemology' (Haraway, 1988; 1997; Harding, 2011; Barad, 2007; 2003) which question and intervene in practices of knowledge construction and bring to the fore issues of politics, ethics and responsibility in engaging with the materiality of the world. These authors and the scholarship they have developed do not have gender and women as primary concern.

The term 'gender' is here inextricably intertwined with that of 'women' as female students and professionals in computer science are significant protagonists of the empirical research. Gender is understood as a relational category (Cozza &

Poggio, 2007; Cozza, 2008; Bruni, Gherardi, & Poggio, 2005) and a product of social, discursive, and material practices (Martin, 2003; Butler, 2004; Thompson, 2005). Understanding gender as a relational construct means to explore the practices that assign feminine traits to women and masculine ones to men, thus unveiling how social inequalities and power differentials are based on such associations. Additionally, understanding gender and technology as relational and mutually shaped concepts means that technical artifacts are designed and produced by gendered systems of labor division as well as symbolically and materially informed by particular assumptions about femininity and masculinity. It follows that female is not defined by default by the male, but it becomes a matter of 'positioning' (Davies & Harré, 1990; Gherardi, 2006), that is the process by which individuals position themselves discursively and materially with respect to humans and non-humans, and construct their identities in relational terms.

Information technology (IT) is another recurrent word of this dissertation. Despite my research primarily examines computing and computer science, I have eventually opted for IT. While I use the terms 'IT', 'computing', 'computer technologies', 'informatics' as synonyms, it is important to outline some distinctive traits among them and the reason of my privileging 'IT' over 'computing'. According to Ronald Kline (2006), the term 'information technology' arose in the United States in the field of management science in the 1960s to indicate computer-based mathematical techniques to replace mid-level managerial tasks. During the 1980s, this knowledge base has been transformed in electronic artifacts and computerized technologies which were promoted through a techno-enthusiastic language.

According to Kline, 'information technology' presents all the features of a keyword insofar as it combines *information*, a common word which became popular thanks to cybernetics and the emergence of computer and communication applications, and *technology*, another keyword considered as a powerful social force (Marx, 1997).

It is precisely during the 1980s that, according to American historian of technology Thomas Haigh, the word IT becomes "a new and more pretentious way of saying 'computer'" (Haigh, 2011, p. 433). Haigh points out that the term 'computing' presents more defined boundaries than 'IT' insofar as it clearly refers to the act of calculation. However, such a semantic delimitation has become narrow as computers rapidly developed their capabilities and applications. At the same time, 'computing' is more descriptive because it directly points to computer technologies and the related activities. Information technology, on the other hand, presents larger boundaries as it refers to computer applications, work practices, cultural meanings, and influence on the world. If 'computing' is a rather specialized term defining mathematical calculation, computer science, and business data processing, 'information technology' is a bridging concept able to put different communities, computer technologies, and disciplinary areas in conversation with one another.

Following Kline, I have chosen *information technology* as the primary keyword of this dissertation because, as a keyword, it points to different meanings, empirical settings, communities, and disciplinary areas that my research has confronted along the way. A similar choice, thus, does not lie in the primary need to flee ambiguity (Levine, 1988), but rather it speaks to the analytical effort to deal with complexity

as any sociological research confronting technology (with the lens of feminist critique) entails.

1.4 Two empirical sites

The theoretical frameworks, analytic sensibilities, and keywords defining the relationship between feminist theory and information technology so far described inform and are problematized through my engagement with two empirical sites. While the ways in which I came to enter them will be discussed in greater detail in Chapter Three, I shall briefly introduce them here.

In the first place, it is important to underline here the value of empirical investigation over categorical debate (Suchman, 2007), especially when a knotty theoretical issue — such as the relationship between feminist critique and IT — is at stake. Indeed, addressing the irreducibility of lived practice, exploring new accountabilities and forms of agencies, enacting silence and invisibility behind any sociotechnical system is pivotal in order to avoid what Rosaling Gill and Keith Grint (1995) has defined as "the tendency to functionalism" with regard to the gender-technology relation. In this research, the "the tendency to functionalism" refers to the danger of explaining the role and design of information technologies in organization as well as the relationship between female practioners with computer technologies and the gender-technology relation in ideological terms, that is by reinforcing and reproducing existing patterns of relations such as the assumption that technology is inherently masculine and that technical systems are, once and for all, either oppressive or liberatory.

Thus, in doing my research I was driven by two notions suggested by the literature on STS and FTS, namely the production of and engagement with "situated knowledge" (Haraway, 1988; Harding, 2004; Harstock, 1987), and the capacity of "cultivating disconcertment" (Law & Lin, 2010; Verran, 1999). Both of them concern a critical reflexive stance toward the production of knowledge as well as the understanding of such production in performative terms. The notion of 'situated knowledge' is a feminist trope which describes the recognition that any form of knowledge is partial, that is constructed within limited locations, by means of specific devices, and with respect to located subjects. A similar acknowledgement requires the researcher to be accountable for his/her role in the story and his/her practices of knowledge construction. To put it in Haraway's words: "it allows us to become answerable for what we learn how to see" (Haraway, 1988, p. 583).

The notion of 'disconcertment' as articulated by Law and Lin (2010) is closely related to that of 'situated knowledge' insofar as it constitutes a "crucial potential *detectors of difference*" (Law & Lin, 2010, p. 137, emphasis in the original). In recognizing that any account of the world is embodied and located, Law & Lin invite to confront messiness by juxtaposing different narratives and descriptions that resist an immediate coherence and, rather, are able to enact different realities.

In this research I have therefore explored the relationship between feminist theory and IT by moving across two different and separate settings. The first one concerns the analysis of networks and initiatives committed to promoting more female presence and gender awareness in computing. I have conducted semi-structured interviews with female professionals in computing fields and carried out

direct observations of some of the events dedicated to attracting young female students to computer science and IT professions. In doing so, I have tried to detect arguments and rhetoric deployed to recruit young female students in computer science and computer engineering academic departments, the discursive practices around gender issues in computing and the relationship between women and computing. Following the idea of 'cultivating disconcertment', my engagement with this setting has been driven by the interest in challenging those accounts, event in feminist writing, which hold that technologies are masculine and that the relation between women and computers is marked by fear and alienation.

In contrast to this field site, in which gender issues are visible and matter of concern, the second setting regards an ethnography I have carried out in an Italian telecommunication company. Here, I have drawn on the idea of 'situated knowledge' to explore the relationship between feminist critique and information technology. More specifically, my research has focused on the work of a specific group and the related development of a digital tool to support collaborative work, which has uncovered not just technical concerns, but conflicts and tensions among different groups as well as the controversial role played by material artifacts as far as the process of organizing is concerned. The notion of 'situated knowledge' has worked as a guiding tension insofar as it has allowed me to recognize the partial and located practice of the goings-on in the field as well as that of my research practices.

1.5 Research questions and contributions

Having introduced the central topics, theoretical underpinnings, keywords, and empirical settings of this thesis, it would be helpful at this point to develop three research questions in order to operationalize these considerations and shape the analysis. These research questions should be understood as interpretative devices rather than definitive demands for answers. Indeed, they provide guidance in approaching empirical instances and suggest directions along which to look at in navigating the fieldwork.

The first issue concerns my sense of uneasiness with the ideological association between technology and masculinity (Grint & Gill, 1995). Although I recognize the value of taking into account such cultural connection, I am interested in probing the relationship between computer technologies and *actual human subjects*, specifically women, which remains an underexplored issue. Such a tension fosters the following research question:

> 1. what is the relationship between female professionals and practitioners in IT and computer technologies? How do women problematize gender issues in their technical field?

The second question specifically regards my ethnographic journey into the IT company and entails the role of materiality and technical artifacts with respect to the process of organizing. The analysis of the literature on workplace studies and my first approach to the field have spurred the following questions:

> 2. what is the role of material artifacts in the process of organizing? What kind of and in what ways do feminist concerns emerge from the investigation of technology in organizations?

The third question represents a sort of return to the initial theoretical and conceptual inquiries and involves specifically the contribution of FTS to the study of technoscientific discourses and practices. More specifically, this concern addresses both the theoretical debate and empirical research as to the role of feminist inquiry in *detecting differences* (Law & Lin, 2011) in the study of information technology:

> 3. How can we respecify such contribution in the light of empirical research? What is the contribution of feminism and feminist approaches to the study of information technology and materiality in work places?

These analytic inquiries will help me to address the theoretical and methodological discussion as well as to disentangle the following empirical instances.

These research questions outline some contributions that this study seeks to provide. In the first place, this dissertation advances a discussion of the relationship between feminist critique and information technology. While it is reasonable to claim that feminist critique of science and technology constitutes a well-established body of knowledge (albeit mostly in the USA and northern European countries), sociological and historical analyses of computing, especially in non-American countries, are still in their early days, and all the more this is true for feminist inquiry. This is also due to the fact that computer science and computer engineering are still relatively young subjects in comparison to other traditional disciplines such as mathematics, biology or physics.

Secondly, this study unfolds two empirical settings in which the relationship between feminism and IT is explored. While I do not disclaim the difficulties to deal

with two field sites with different features — a closed organization on the one hand, and open and visible networks on the other —, such difference constitutes a value by all means insofar as it shows how the analytic inquiries so far described can be investigated in different settings through a variety of methods. The result is somewhat similar to what David Silverman has defined as "triangulation" (Silverman, 2006), that is the use of multiple methods and analytic sensibilities to render the heterogeneous character of the issues under scrutiny. However, my aim is not that of reporting an "objective representation of the object of study" as Silverman claims (p. 291) since the theoretical underpinnings of this research have in their core precisely critical and articulated viewpoints on the concept of 'objectivity' (see Daston &, Galison 1992; Harding, 2005).

Finally, considering the empirical research findings, this study offers a contribution to the sociological debate as to the study of information technology through feminist lens. This brings about two overall suggestions: it invites to focus on the role of materiality and digital artifacts so as to detect affordances, relations and conflicts they enact as well as "questions of voice and silence" (Star, 1995, p. 10); on the other hand, encounters with women engaged with gender troubles in IT have allowed me to go beyond the assessment of those mechanisms of discrimination and segregation — glass ceiling, leaky pipeline, sticky floor, stereotypes — well-articulated in the literature, in order to explore how they relate with their own discipline and technologies.

2. FEMINIST STUDIES CONFRONT SCIENCE AND TECHNOLOGY

As feminist physicist Karen Barad has argued (2011), feminist science studies, for all its diversity and because of all its diversity, was never a subfield of science studies exclusively engaged with the analysis of gender relations and women's condition, but rather it has been developing as a rich and polyphonic body of knowledge and research with ethical and political commitments to a variety of issues — from environmental sustainability to biomedicine and new reproductive technologies, from the transactional and domestic sexual division of labor in technoscience to the gendered shaping of technoscientific cultures and practices. in this regard, Judy Wajcman (2010) suggest that rather than thinking of feminism, we should think of as multiple and dynamic feminisms — plural — engaged in processes of ongoing transformation.

In this chapter I shall draw the lines of the theoretical debate over the study of science and technology through the lens of feminist critique. I shall start out by presenting the more evident issue of female discrimination scientific fields to the more nuanced critique of practices and political aims behind the production of scientific epistemologies. This second line of inquiry presents different, though connected, approaches that go from the standpoint feminism (Harding, 2001) to

the notion of “situated knowledge” (Haraway, 1988) and to the recent turn to ontology and materialism in feminist STS (Barad, 2007; Alaimo & Hekman, 2008; Hekman, 2010).

In the further sections, I shall connect such debate to the feminist studies of technology, with particular attention to the concept of ‘practice’ as a critical heuristic (Orlikowski, 2000; Gherardi, 2009) whereby to investigate technology as a “social practice” (Suchman, Blomberg, Orr, Trigg, 1999), that is understandable only in its relation to the sites of production and use. Such an understanding of technology as a “social practice” pairs with an equally way of conceiving of gender relations and identities as performed and socially achieved (West & Zimmerman, 1987; Butler, 1990; Connell, 1995). Similar analytic assumptions invite researchers to pay attention to the specificities of knowing subjects and material arrangements, which are multiple and differentially positioned as well as engaged in reiterative and transformative practices of world-making (Suchman, 2007). The act of interrogating the phenomena under investigation as situated into specific contexts and ordinary activities between humans and non-humans allow us to question those boundaries that commonly define binary oppositions such as subject/object, structure/agency, practice/knowledge, user/producer, skilled/unskilled, hardware/software, male/female, which are not stable and natural at all, but rather socially, discursively and materially constructed in different times and places.

The concluding paragraph concerns the development of feminist approaches to the analysis of computing (Adam, 2000; Adam & Richardson, 2001; Björkman,

2005; Misa, 2010; Abbate, 2012; Harrison, Sengers, & Tatar, 2011; Muller, 2011; Rode, 2011). As in the case of the feminist critique of scientific knowledge, the reflection and research on computing and computer technology has addressed both the processes of female discrimination in educational and professional paths and the birth and development of computing as professional and technical culture imbued with assumptions about the status of men and women and cultural understandings of femininity and masculinity.

2.1 Feminist critique of scientific knowledge: the debate

As interdisciplinary field receptive to political causes, STS, like other fields in the humanities and social sciences, was remarkably affected by issues raised by the feminist movement, especially the so-called "second wave" feminism, which began during the 1960s and become established along the 1980s in Western countries. To reconstruct in detail the different stances within feminist thought related to the study of science is a grueling task and not the purpose of this thesis, which primarily focuses on the intersection of feminist critique and IT[1]. What I would like to do in this section is rather to draw the main lines of inquiry characterizing the debate around feminist approaches to the construction of scientific knowledge.

As Sandra Harding points out (1986), feminist critique of the natural sciences remains more fragmented than feminist analyses in other disciplines given the

[1] Here I just mention some valuable contributions, without the pretension to be exhaustive: Haraway (1991), Schiebinger (1999), Cherubini, Colella, & Mangia (2011).

recognition that scientific culture and scientific rationality pervade our modes of thinking, acting, and even the ways we think about the most intimate details of our private lives. Such contradictions do not originate in the feminist critique in itself, but it has to do with the changing and ambivalent arrangements of gender, race, class, and science. The following sections, therefore, summarize the main research programs developed by feminist theory with regard to the critique of science as a social system and the production of scientific knowledge. These critiques move from the question of women discrimination and invisibility in scientific fields to critique of practices and political aims behind the production of scientific epistemologies. I shall depict such theoretical trajectory without the claim to smooth out a rather intricate debate, but rather by underlining its polyphonic nature.

2.1.1 The Women Question in Science

As Sandra Harding points out, there are many feminisms (Harding, 2001, p. 147), and each of them can be understood through the meanings they assigned to women's experience and to the notion of 'gender'[2]. Historical analysis on women in science is an important line of inquiry, which focuses on female scientists who have been ignored or dropped from public recognition and historical record. As Lynch (2012) explains, this body of works is not necessarily feminist-oriented since it

[2] Gender studies is an interdisciplinary and very heterogeneous field of study. It includes women's studies, men's studies, queer studies, which are populated by a great number of analytical approaches and viewpoints. Here I would like to name a few chief titles in the field: Rubin (1975), Scott (1986), Crenshaw (1989), Connell (1986), Butler (1990).

largely consists of demographic and survey-analytic studies on the one hand, and research on biographies of female scientists who have been neglected by mainstream accounts as well as noticed couples in science on the other[3]. Even though statistical analyses tend to view gender as just a variable whereby to assess the composition of men and women in technoscientific education paths and careers, they are of great importance for identifying mechanisms of imbalance and discriminations, such as "glass ceiling", "leaky pipeline", "sticky floor", which help to design strategies of intervention to get more women in STEM fields.

On the other hand, historical approaches to the study of women in science constitute a research program that aims at recovering the *visibility* of significant female figures that were deliberately kept out from due recognition (see Wyer, Barbercheck, Geisman, Öztürk, & Wayne, 2001). In this regard, Margaret Rossiter coined the term "Matilda Effect" (1993) precisely to describe the systematic repression or underrecognition of the contribution of women in science and research, whose work is often attributed to their male colleagues. Rossiter cites multiple cases that show how the presence of women in science and engineering has been undercut, undercounted and minimized to the advantage of male figures. The "Matilda Effect" is openly put in conversation with the "Matthew Effect" described by Robert Merton and his colleagues. According to Rossiter, paying attention to the role of female scientists and female collaborators represents a turning point in the attempt to write more comprehensive – thus better – historical and sociological accounts of science. The American historian, then, addresses

[3] For a valuable historical analysis on women in science, see Rossiter (1984; 1998; 2012).

questions related to women reputation in science, describing how just a few women – such as Marie Curie and Maria Goeppert Mayer – achieved due recognition during and after their own time. Moreover, Rossiter points out that even those women who were well-known in their days have been made invisible in historical accounts, either by laziness or on purpose.

The cases of marriage between scientists are particularly interesting since they reveal strategic plans that male scientists often undertook in order to undermine serious rivals in the race for recognition (Rossiter, 1993, p. 330). This is the case, for instance, of Ruth Hubbard and George Wald, who worked on similar problems in biochemistry, but when he won the Nobel Prize in 1967, he got credits for all her previous work. Additionally, the undercount of women occurred not only to individual cases, but also in the aggregate. Rossiter, indeed, mentions a number of studies and statistics – like *McGraw-Hill Modern Men of Science* (1966) or *the Dictionary of Scientific Biography (1979-80)* – that are clearly gender-biased (the former) or that underrate the number of women (the latter).

Rossiter does not fail to underline that this dynamic of systematic repression of women's contribution occurs in social sciences too. She adopts a tongue-in-cheek tone when, in searching for an apt name to describe the invisibility of women in science, she gives a try with "Harriet Effect" in honor of Harriet Zuckerman, the Merton's collaborator who did most of the work that led to the formulation of the "Matthew Effect". Such clear lack of acknowledgment of Zuckerman's contribution was recognized by Merton himself when, in the second version of the article on the "Matthew Effect" (1988), he admitted that Zuckerman should have been regarded

as co-author. However, Zuckerman achieved a significant prominence within academic community anyway, as a full professor at Columbia University and past president of the Society for Social Studies of Science. As a consequence, Rossiter found a suitable name in that of Matilda Joslyin Gage (1826-1898), who was a nineteenth-century American feminist and suffragist. Besides dedicating her efforts to the suffrage cause, Gauge devoted her time to reinterpret the Bible through a feminist lens as she thought that Christianity and Biblical stories downgraded women.

The elaboration of Matilda Effect and its emphasis on returning visibility to female scientists represents a fruitful link between quantitative analyses that use gender as a statistical variable to evaluate the presence of men and women in technoscientific fields and those feminist perspectives that point out a specific question concerning epistemology (see next section). Such a shift is not intended here as a linear transition by which one line of research should exclude the other. On the contrary, the sexist nature of women's systematic underrepresentation in science and technology is an unavoidable passage point to start any discussion on the nature of knowledge and its political implications. In other words, I argue that the issue of *visibility* of men and women in technoscience is naturally entrenched with that of *vision* entailed by feminist epistemology, that is the discussion over contents, values and ethics concerning scientific knowledge.

2.1.2 The Science Question in Feminism

The "women question in science" articulated in the previous section draws on a enquiry informed by equity studies, tracing formal segregation and discrimination that prevent women from entering scientific education (Rossiter, 1982; Valian, 1999). Such studies have also unveiled psychological and social dynamics whereby an informal discrimination is maintained even when women accessing scientific careers, whereas another branch of research have uncovered the uses of scientific disciplines, like biology, in the service of sexist, racist, homophobic, and classist social projects (see Harding, 1986). According to American feminist philosopher of knowledge Sandra Harding, despite their relevance, these studies assume that there is a value-free pure scientific research that can be distinguished from its social deployment, and that it is also possible to discern proper uses of scientific research from improper ones. In Harding's view, scholars from the "women science" position advocate gender equity within scientific realms, then conceiving of science as "reformable" and "redeemable", without questioning the very content of scientific enterprise.

Unlike such liberal positions, Harding argues that feminist epistemologies have provided a more radical critique of science, which question practices, values, assumptions and power relations behind the production of knowledge. In Harding's words, this form of criticism marks a move from the *women question in science* to the *science question in feminism* (Harding, 1986, p. 29). According to the American scholar, the main shortcoming of the "women question" research programs relies on the limited conceptualization of gender, which has long been understood as a

mere statistical variable to highlight the lack or invisibility of women in science. In order to provide a more nuanced critique of the roots of the Western, male, white knowledge, gender should instead be taken as analytical category in order to probe how the division of social life for men and women has been shaped through metaphors and symbols (*gender symbolism*), dualisms in the organization of social activity and division of labor (*gender structure*), and with socially constructed individual identities "imperfectly correlated" with sex differences (*individual gender*). Such revolutionary critique of traditional epistemology aspires to promoting a "better" science, with emancipatory aims, and driven by the ethical compass of "strong objectivity" (Harding, 2001).

This concept draws on the feminist epistemology informed by the standpoint theory, which revolves around social relations as topics and resources of knowledge production as much in physics and mathematics as in primatology and psychology (see Sismondo, 1995). Although their divergences and variety of issues they address, feminist authors related to standpoint theory (Harstock, 1987; Smith, 1987; Hill Collins, 1986; Harding, 2001) gather around the assertion that feminist standpoint is a privileged perspective from which to observe the mechanisms and conditions behind the construction of knowledge. Such line of thought stems from Marxist theory, particularly Georg Lukàcs' argument of the privileged standpoint of the proletariat (Lukàcs, 1971 cited in Sismondo, 1995). According to standpoint, subjects commonly located in marginal positions (proletariat, women, black people, disables, gay people etc.) can take advantage of a better vision of and break out the rationalized structures and system of injustices they contributed to create.

In the essay titled *Feminist Standpoint Epistemology*, Harding (2001) provides a feminist version of standpoint epistemology related to scientific knowledge. According to Harding, the place from which feminist research should begin to generate new research projects both in natural sciences and social sciences is that of women's lives. The reasons why women's position is privileged rely on their *strangeness* to the dominant system of values, so that they can better provide causal explanations – rather than understanding – of beliefs and behaviors. Moreover, as coming from a position of oppression and exploitation, women have less to lose by distancing themselves from the social order, so they better engender fresh and critical accounts of the relationship between science and society. Starting from this assumption, Harding formulates the idea of "strong objectivity" in contrast to cultural relativism and epistemological relativism, which, in her opinion, disregard the possibility to identify ethical standards of judgment among competing claims.

2.1.3 Situated knowledge, partial perspectives, and the emergence of the "Who" question

The emergence of a modern feminist critique of science has allowed science studies and feminist studies to converge, elaborating a body of work that for all its diversity and because of all its diversity cannot be considered as a subfield of science studies (Barad, 2011).

In response to the notion of "strong objectivity" advanced by Harding, Donna Haraway claims that "[the] knowing self is partial in all its guises, never

finished, whole, simply there and original" (Haraway, 1988: 586), thus postulating any idea of 'objectivity' as the "view from nowhere". Haraway crafts a specific notion of 'situatedness' from arguing against both radical constructivism and feminist critical empiricism. In her view, radical social constructionist programs limit their work to show bias in science and official ideologies in scientific method without being engaged in the political arena. On the other hand, feminist empiricism would fail in its reliance on a legitimate meaning of objectivity while criticizing science. In Haraway's view, feminist critique of science should pursue better accounts of the worlds by taking distance from any temptation of objectivist claims.

It is interesting to point out that both Harding and Haraway employ visual metaphors to put on the table different positions on feminist epistemology. If, for Harding, standpoint is not the same as a perspective or simply "opening one's eyes" (Harding, 1991: 150), Haraway holds an idea of vision as an embodied and always partial way of perceiving the world. All vision is partial; nothing or no one can see everything, and each being sees differently. Thus, while Haraway's situated knowledge comes very close to 'standpoint' in keeping in mind where knowledge comes from, its key difference is the (re)addition of vision, embodiment and materiality.

It is worth noting that the distance that Haraway marks from any claim of objective knowledge or attempt to objectively deconstruct scientific facts or, still, from Harding's "strong objectivity" also emerge from her style of writing. Her most popular texts – from *Manifesto Cyborg* to *Modest_Witness* – are indeed rife with

provocative metaphors that she openly takes from science fiction literature in order to shape her idea of feminist science studies (Campbell, 2004). The figure of the "god-trick", for instance, is powerful insofar as it enlightens the pitfalls of both relativism and totalization, regarded as "twins" in the ideology of objectivity. The issue of "vision" animates Haraway's thought on feminist epistemology and her argument about knowledge as situated and the privilege of holding a partial perspective. She insists on the fact that the only rational knowledge possible is that coming from a local position, which is at once condition and outcome of any rational reasonable claim. The situated knowledge that Haraway calls for, then, reveals its embodied nature and the political commitment of which feminist epistemology is informed:

> I am arguing for politics and epistemologies of location, positioning, and situating, where partiality and not universality is the condition of being heard to make rational knowledge claims. These are claims on people's lives. I am arguing for the view from a body, always a complex, contradictory, structuring, and structured body, versus the view from above, from nowhere, from simplicity. Only the god trick is forbidden. Here is a criterion for deciding the science question in militarism, that dream science/technology of perfect language, perfect communication, final order. (Haraway, 1988: 589)

If Harding's "strong objectivity" and Haraway's "situated knowledge" hold different positions as to the assessment of objectivity, they are both characterized as being "local epistemologies" (Longino & Lennon, 1997). In other words, their stance towards objectivity aims to avoid value neutrality and to reintroduce a normative

claim into the analysis of science by emphasizing the question of "who", besides that of "how". Sergio Sismondo calls it "an illegitimate question":

> Traditional epistemological inquiries center on finding the conditions for knowledge, the conditions that allow one to say, S knows that *p*. Standpoint epistemology challenges some common assumptions of this traditional problem by asking the illegitimate question, Who is S? – an illegitimate question because it assumes that the identity of the knower matters in evaluating the knowledge claim and, in particular, that the sex or gender of the knower matters. […] the question Who is S? and What gender is S? are illegitimate because epistemology has fashioned itself around the problem of refuting or promoting skepticism, and S's identity does not matter much when there are Cartesian demons or their modern descendants around. (Sismondo, 1993, p. 53)

The "who question" is also taken up by Susan Leigh Star (1991) in her critical reading of Bruno Latour's account on the constitution of networks as exemplified in the *Pasteurization of France* (1993). According to Star, Latour's marshal narrative places one male, powerful actor – French chemist and microbiologist Louis Pasteur – and his laboratory at the center of the network and basically neglects to account for marginal positions along with all humans and non-humans actors that are kept outside the networks. Such an approach, Star argues, fails to see and problematize issues of exclusion and violence as well as of extension and power. Along with Sismondo's question "Who is S?", Leigh Star quests: *cui bono*?

2.1.4 Material-semiotic entanglements and ontological inquiries: FTS re-read materialism and ontology

The tension between realism and social constructivism wherein both Harding and Haraway are embedded is somewhat overcome by feminist physicist Karen Barad. She claims that such polarization, which implies a subject/object dichotomy, can account for the situated and constructed character of only one pole at a time (Barad, 1999). Based on her work as theoretical physicist, who "rarely ventures into the basements of physics buildings experimental colleagues call 'home'" (Barad, 1996, p. 161), Barad introduces the notion of 'agential realism', which she describes as "an epistemological and ontological framework that provides an understanding of science as 'material-discursive' practices" (Barad, 1999, p. 2). These material-discursive practices spontaneously remind to the "material-semiotic generative nodes" of Haraway's situated knowledge (Haraway, 1988, p. 595). Unlike Haraway, however, Barad seeks to recompose the terms of the subject/object dichotomy by claiming that scientific practices are productive by means of different apparatuses, rather than simply descriptive.

Barad seeks to recompose the terms of the binarism that in the production of scientific knowledge presumes agencies of observations and objects of observation as irremediably separated from each other. To back her argument, she deploys the concept of 'intra-action', as opposed to that of interaction, to signify the mutual constitution of subjects and objects. An example of such co-constitution, according to Barad, is Niels Bohr's work on quantum physics and the epistemological issues that come from it. In Barad's reading, the Danish physicist

and philosopher, indeed, took exception to Newtonian ideas about the flaws in its notion of 'transparency of observations', which grounded in two basic assumptions: (1) objects of observations have intrinsic properties that can be related to abstract universal concepts and (2) that the properties obtained by the measurements are always determinable, so that they depend on objects of observation, which are independent from the subjects of observation. In other word, according to Barad's interpretation of Bohr's framework, classical physics presumes a clear separation between human agents (scientists) and the practices, devices, standards of measurement they work with. It follows that the former has no accountability issues to take on since the whole responsibility for the measurements are attributed to the objects. On the contrary, Bohr argued that "*theoretical concepts are defined by the circumstances required for their measurement*" (Barad, 1999: 3, emphasis in the original). Bohr's epistemological framework, then, relies on "quantum wholeness", that is the lack of an inherent distinction – thus the impossibility of inter-action – between object and agencies of observation.

Barad's feminist reading of Bohr's physics is theoretically informed by Michel Foucault and makes use of diffractive methodology through the framework of agential realism. Diffraction is another optical metaphor that Barad borrows from Haraway (2007) and sets up to highlight interferences and intra-actions among different apparatuses from which both subjects and objects emerge[4]. The emphasis on realism, rather than constructivism, refers to a type of reality that is dependent

[4] With the term 'apparatus', Barad includes not only instrumental tools, but also the economic system, scientific practices, techniques, gendered and raced divisions of labor, data, which construct both subjects and objects.

on human practices and transformed through material-discursive intra-actions. Unlike constructivist approaches, agential realism marks out a reality that is not a premise of the representational nature of knowledge. The focus, here, is not on the ways whereby facts are constructed trough rhetoric and inscription devices (Latour & Woolgar, 1986 [1979], Viteritti, 2012) nor on a reality that is "out there" and that social scientist has to investigate without being in the action, finite and dirty, to use Haraway's words (Haraway, 1997: 36).

The ontology that Barad and Haraway point out is informed by principle of responsibility, accountability with regard to the processes and practices we intra-act to make the world intelligible. "Therefore, we are not only responsible for the knowledge that we seek but, in part, for what exists" (Barad, 1999: 7).

2.2 Gender and technology: interrogating boundaries through the concept of 'practice'

2.2.1 Feminist perspectives on technology

In the previous paragraph, I have sketched some of the most relevant lines of inquiry in feminist critique of scientific knowledge. In line with the main arguments developed by this heterogeneous body of knowledge, feminist scholarship within the field of technology studies have mostly addressed three macro-issues (Cozza, 2008): the introduction of information systems in offices and domestic spaces

(Cockburn, 1992; Lie, Sørensen, 1996; Green, Owen, & Pain, 1993; Schwartz Cowan, 1989), the increasing employment of cheap female workforce in developing countries (Webster, 1996; 1999), the critique of reproductive technologies (Oudshoorn, 1999; Wajcman, 1991).

Sociologist Wendy Faulkner (2001) argues that, whilst several established streams of feminist scholarship have assessed the implications of technological development, technology *per se* has been generally neglected. In accordance with the "women question in science", the stream within feminist scholarship on technology called "women *in* technology" (Cozza, 2008; Faulkner; 2001) questions the shortage of female presence in technology industry. Sticking to a liberal approach, this branch of studies confronts mechanisms of segregation and discrimination towards women in technology industry, whereas technology is seen as a neutral issue. With regards to this line of inquiry, British sociologist Judy Wacjman (2010) points to the sexual division of the labor market, where men are more likely than women to be found in high-tech jobs. As Wacjman remarks, the "gender deficit" evident in the technoscientific job market keep women away from the crucial processes of technical design and production that shape the world we live in. In this framework, interventions in term of socialization processes and equal opportunity policies are advanced in order to address issues of sex segregation and employment discrimination that affect women

The stream "women *and* technology" overcomes the obvious issues of gender equity in technological realm, and examines the position of women as end users of particular kinds of technology such as Internet and reproductive technologies.

According to Faulkner, this line of thought tends to hold a dichotomous understanding of technology, seen either as a masculine instrument of control or as an opportunity for women emancipation. Still, technological artifacts are taken as black boxes and there are no questions regarding their inner articulation and ambivalence.

In contrast to the approaches so far described, other feminist scholars have conceived of their research in terms of "*gender* and technology", questioning the mutual shaping of gender relations and technology (Cockburn & Omrod, 1993; Wacjman, 1991; Cowan, 1983). Similarly to the Harding's "science question in feminism", this stream of scholarship demonstrates how the relationship between gender and technology concerns three levels of analysis: social structures and division of labor, symbols, language, culture, and gender identities.

2.2.2 Technology as social practice

Is technology a "hazardous concept"? American cultural historian Leo Marx makes such an argument based on a historical reconstruction of the emergence of 'technology' as a keyword (Marx 2010). According to Marx, the word 'technology' first entered English language in the seventeenth century, but it in fact gained popularity in the 1930s, when it got out of academic and intellectual circles and achieved public discourse. As cultural historian, Marx points out that the concept of 'technology' came forth both to signify radical changes in society and culture and as a product of those very changes it proposed to analyze. In other words, the term 'technology' came out with a new and extended meaning to fill the conceptual and

semantic void left by the profound transformations in mechanic arts and the rest of culture and society such as the railroad and the telegraph regarded as complex sociotechnical systems that took over the 'discrete machine' (Marx 2010, p. 567) – such as the spinning jenny, the power loom, the steam engine, the steamboat, the locomotive, the dynamo – and fueled a master narrative of progress that equated human and social advancement with mechanical innovation. Notwithstanding such cumulative idea of progress in the nineteenth-century America, there were also emergent critical positions – held by intellectuals such as Henry Thoreau and Herman Melville – of the new industrial arts, which rejected the dominant faith in progress as a self-justifying, social goal, and which, according to Marx, travelled from Thoreau's call for 'civil disobedience' to countercultural movements of the 1960s[5]. What is "hazardous" in the concept of technology then? In Marx's view, the hazard relies on the apparent transparent and objective-like nature of technology, an "intangible" and "neutral" word adopted to literally name a new form of human power by "clean, well-educated, white male technicians in control booths watching dials, instrument panels, or computer monitors" (Marx 2010, p. 574). According to Marx, therefore, the concept of 'technology' is hazardous because of its dominant understanding, which makes it a general and "dispassionate word" (Marx 2010, p. 574) by concealing its relations with people, structures of power, bureaucratic and ideological components, cultural beliefs, and – I add — assumptions about gender.

A widespread attempt to attend Marx's recommendation to "expose the hazards" (Marx 2010, p. 577) embodied in the concept of technology, so as to

[5] Marx clarifies that the nineteenth century was the temporal stage wherein the 'Second Industrial Revolution' began with the eruption of mechanical inventions.

deconstruct the still common deterministic view on sociotechnical systems (see MacKenzie & Wajcman 1999), is undertaken by science and technology studies and, in particular, by those approaches that investigate technology through the critical lens of practice. One of the most influent among them is the structurational model of technology elaborated by Wanda Orlikowski (1992). She provides an extensive enrichment of Giddens' theory of structuration (1984) by investigating the role of technology within organization. Far from making structures susceptible to reification (the biggest "hazard" in Marx's words), Orlikowski explains that structures are neither external to human action nor the form of the social, but rather they enact the social by way of social practices, which are contingent and situated. She then employs the tenets of structuration theory to reconstruct the concept of technology by putting forth three analytical moves: restricting the scope to material artifacts (hardware and software differently assembled), making a theoretical distinction between the material nature of technology and the human activities that design and use the artifacts, conceiving of material artifacts as the outcome of coordinated human action, thus as inherently social (Orlikowski 1992, p. 403). According to this standpoint, such recurrent practices produce and reproduce particular structures of use of technology, so that they give shape to the set of rules and resources that marked such interactions. The duality of technology is the core of Orlikowski's interpretation of Giddens' model, that is to say that technology is created and changed by human actors, yet it is also used to accomplish some actions. Such an understanding of the role of technology brings to the fore the

heuristic power of “practice lens” that Orlikowski herself emphasizes in another article (2000), extending the structurational perspective:

> A practice lens more easily accommodates people's situated use of dynamic technologies because it makes no assumptions about the stability, predictability, or relative completeness of the technologies. Instead, the focus is on what structures emerge as people interact recurrently with whatever properties of the technology are at hand, whether these were built in, added on, modified, or invented on the fly. (Orlikowski, 2000, p. 407)

As exemplified here, the use of practice lens to investigate how people interact with technology unveils structures as *emergent* from such interactions, rather than embedded. Moreover, the alleged stable, predictable and complete character of technologies is called into question by the situated use of them. This conversation between the structurational perspective on technology and practice-based tenets allow us to envision the double movement that run through interactions and structures: on the one hand, human actors enact emergent structures through practices with technology, whereas certain kind of practices structure human actions.

The view of technology as social practice has been directly developed by Suchman and colleagues, who claim that design of new technologies brings about new configurations between the social and the material: “systems development is not the creation of discrete, intrinsically meaningful objects, but the cultural production of new forms of practice. As practice, technologies can be assessed only in their relations to the sites of their production and use” (Suchman, Blomberg, Orr,

Trigg, 1999, p. 404). This formulation aligns with Orlikowski's argument since both of them give prominence to the ecology of sociotechnical knowledge and practices that the introduction of new technology mobilizes and reconfigures.

2.2.3 Gendering practices and practicing of gender

In 1987, Robert W. Connell outlined a practice-based approach to the study of gender relations. His main concern was that of rendering masculinity and femininity as lived experience and social processes rather than an outcome of a pre-given structure. Such understanding of practice as the substance of gender relations has been taken up and further developed by those studies that emphasized the symbolic and performative character of gendering (Butler 1990) both in organizational theory (Gherardi, 1995) and in those studies specifically related to information and computer technologies (Edwards 1990, Eriksson-Zetterquist 2007, Misa 2010).

If Leo Marx, as we have seen in the previous paragraph, remarks the importance of assessing the concept of 'technology' through a historical gaze, Connell claims somewhat the same for the understanding of 'gender', when she states that "without historicity, a politics of transformation becomes irrational" (Connell, 1987, p. 93). The reason why Connell is devoted to trace the historicity of gender relations concerns the attempt to deconstruct the persistent assumption that gender is the natural outcome of sexual dichotomies of bodies, male and female. The reference to practice as theorized by the practice-based approach is crucial in order to understand historical contingency of gender relations in contrast

to a strong tendency in feminist thought, which, according to Connell, has always emphasized the persistence of a single gender structure that sets up the subordination of women and the superordination of men. Ultimately, gender practices, Connell claims, are always responding to a situation.

Such an understanding of gender relations as situated practice speaks greatly to an ethnomethodologically-informed approach that investigates gender as a recurring accomplishment in ordinary interaction. In this regard, Candace West and Don H. Zimmerman (1987) speak of "doing gender" to point out the set of micropolitical activities, interactional achievements and specific competences undertaken by men and women as member of a collective. It is clear, then, that the gendered alleged nature of men and women, far from being a property of individuals, is an emergent feature and a performance set in social situations: "both an outcome of and a rationale for various social arrangements and as a means of legitimating one of the most fundamental divisions of society" (West & Zimmerman, 1987, p. 126).

Following Connell's argument about practice and practicing of masculinity/masculinities (Connell, 1995) rather than the generic dynamic of doing gender, Patricia Y. Martin (2003) argues for a conception of gender dynamics as two sided: *gendering practices* and *practicing gender*. According to Martin, there is a difference between "gender practices," "gendered practices," and "gendering practices", which relies on the fact that practices per se are conceptually distinct from people who practice them (Martin, 2003, p. 354). Practices are thus potential actions available to be displayed, performed, asserted, but the very act of "practicing" is contingent, complex, subtle, tacit and immediate. Sociologists —

Martin claims — have to take up the study of such micro-interactional practicing dynamics, so as to explain the actual "saying and doing" gender, rather than only to account for the gender that is "said and done". In this regard, it is interesting to notice Martin's reflexive concern for the researcher's positioning, able to stimulate or inhibit discourses and behaviors that, in her/his absence, may be different. As we shall see in the next chapter, feminist studies have compellingly challenged methodology as far as the researcher's positioning is concerned.

2.2.4 The gender-technology relation: challenges and dilemmas

As we have seen previously, the practice lens is the analytical and empirical compass that drives the understanding of gender relations and technologies as social phenomena. Practices — understood as a set of customary activities, local improvisations, and discourses – are the fundamental link that ties technology and gender together.

In the last twenty years, a significant number of sociological and historical studies have enlightened the intersection of gender, technology and society. These authors have emphasized gender and technology as "entwined categories" (Lerman, Oldenziel, & Mohun, 2003) able to question not only the scant presence of women in technical educational paths and workplaces, but also the very concepts commonly associated to scientific and technological development: 'progress', 'knowledge', 'innovation', 'rationality', 'power' (Wajcman, 1991). Instead of aiming at drawing a general theory of the relationship between gender power relations and technology, feminist studies of technoscience have pointed out the analytical

richness and the empirical challenge of studying technology and gender as relational achievements constituted in situated practices (Haraway, 1988; Barad, 1998; 2003).

Such theoretical assumptions invite research questions that pay attention to the specificities of knowing subjects and material arrangements, which are multiple and differentially positioned as well as engaged in reiterative and transformative practices of world-making (Suchman, 2007). What is the role of gender assumptions in *practicing* technologies? Are technologies inherently masculine or feminine? If technology is gendered, how could we detect such gender patterns? What is the contribution of feminist studies to the investigation of technology? These questions pertain to both analytical and empirical level, and are deeply embedded in the practices of design, consumption, use and re-use of technological devices. But what is the role of 'practice' in envisioning the boundaries between gender and technology? The main contribution of practice-based studies to the analysis of social issues such as labor, science, media, education, disability, etc. is that of situating phenomena under investigation into specific contexts and ordinary activities between humans and non-humans, ordered through sets of norms and cultural habits that regulate the division of roles as well as the system of interpretations and communications shared by social actors (see Orlikowski, 1992). It turns out, then, that those boundaries that commonly define binary oppositions such as subject/object, structure/agency, practice/knowledge, user/producer, skilled/unskilled, hardware/software, male/female are not stable and natural at all, but rather socially, discursively and materially constructed in different times and

places for multiple reasons. Accordingly, technologies are not just single objects and machines, but involve people, activities, knowledge, ideologies, assumptions associated to categories of race, education, work, religion, femininity and masculinity; by the same token, meanings and images associated to 'maleness' and 'femaleness' rely on specific material artifacts and technical practices, which is a way to sort people and technology out and to assign power in particular situations (Lerman *et al*., 2003).

It follows that the purpose of gender/feminist studies of technoscience as well as the present work is not that of attempting a general theory of technology, but, as Wajcman (1991) remarks, is that of developing new empirical work to nail down the specific social interests that shape expertise, practice and materiality of particular kinds of technology. At the same time, following Gill and Grint (1995), it is also important that we do not foreclose the possibility of constructing more wide-ranging theoretical understandings of the gender-technology relation. Since the argument by which such relation deserves attention has been generally acknowledged, the task now is to explore the nature of such interplay in theoretical, methodological, and political terms.

2.3 Toward a feminist understanding of computing

2.3.1 Setting the course: the shortage of women in computing

In underlining the importance of figures and numbers for identifying problems and monitoring the effectiveness of remedies, British sociologist Hilary Rose warned: "no statistics, no problem, no policy" (She Figures, 2003, p. 15). Such quote accompanies the introduction to the *She Figures 2003* report, a two-year research effort sponsored by the European Commission and aimed at monitoring male and female employment and gender equity in science. The lack of women in computer science training programs and jobs is a phenomenon that has been well documented over the last years (She Figures, 2012; Hill, Corbett, & Rose, 2010; Hayes, 2010). Despite academic programs in computer science are relatively younger than other scientific disciplines such as chemistry, biology, mathematics, they registered one of the lowest percentages of female students. According to the last edition of the She Figures report, the fields of science, mathematics and computing and especially of engineering, manufacturing and construction are characterized by a strong gender imbalance. Other recent studies, mostly quantitative-based, trace the declining number of women interested in pursuing a computer science degree in the U.S. (Hill, Corbett, & Rose, 2010).

Besides monitoring the gender equity in technoscientific studies and careers, this line of research is driven by a fundamental question: why so few women in fields such as computer science and engineering? The search for causes and comprehensive insights aims at developing remedies and policies in order to make

science and engineering program appealing for female student. One of the best-known researches in this area is Jane Margolis and Allan Fisher's *Unlocking the Clubhouse* (2002). The book is the outcome of a multiyear "insider-outsider" collaboration, wherein a social scientist working on gender and education (Margolis) and a computer scientist concerned about the scarcity of women studying computer science (Fisher) join forces to investigate the living dynamics of the absence of women in computer science at Carnegie Mellon University, a leading worldwide center in computer education. Margolis and Fisher, both professors at Carnegie Mellon, conducted 230 interviews with over 100 male and female computer science students over four years (from 1995 to 1999) in the same university, to understand how men and women approached and experienced computing in college and beforehand, so that to identify productive actions to remodel educational policies and make computer science program more girls and women friendly.

Among the most interesting findings conveyed by the study there is the claim that computing is regarded as "male territory" (p. 4) from early childhood through college. According to the authors, such link between boys and computers is by no means an ascriptive trait, but rather an assumption nurtures by culture and society. By the same token, girls are reported to show disinterest and disaffection towards computer science (see also Chan, Stafford, & Chen, 2000). Fisher and Margolis claims that such feelings are neither genetic nor accidental, but rely upon multiple external factors such as the encounter with a technical culture that women perceive

as distant from them as well as a variety of discouraging experiences with teachers, peers and school programs.

Clearly, issues concerning the decreasing rate of women studying computer science and the related strategies to foster inclusion point also to the nuts and bolts of system design (Balka, 2000), namely concerns ranging from epistemological issues in computing, design approaches, problems with user representations. In the following section, I shall illustrate how such relationship, while appearing predictable, unveils controversial issues.

2.3.2 Feminist research and computing: a fruitful dialogue

The caveat by which there are many feminisms usually recalled by several scholars in the field of science and technology (Harding, 1988; Lykke, 2010; Faulkner, 2001) is by all means true even in the case of computer technologies and IT. Besides those lines of inquiry interested in detecting and monitoring the presence of women in IT studies and industry, there is indeed another stream of feminist research focused on epistemological questions (Adam, 2000; Adam & Richardson, 2001; Björkman, 2005; Harrison, Sengers, & Tatar, 2011; Muller, 2011; Rode, 2011). Generally, this research strand claims about the necessity and fruitfulness of feminist critique in the various branches of computing (information systems, HCI, CSCW). At the heart of such approach there is the claim to go beyond the assessment of female presence or the assessment of training and careers, to tackle the tenets of computer science through the lens of feminist epistemology.

Alison Adam (2000), for example, argues that developments in the theory of information systems (IS) should be scrutinized within the feminist gaze. This is crucial not only to enrich the critical school of information systems, but also for unmasking the power asymmetries that liberal approaches may disregard or reinforce. Drawing upon feminist critique of traditional epistemology, Adam suggests to assess IS's epistemology under the same terms. More specifically, she contends that the emerging critical school in IS, which relies upon interpretative and social constructionist approaches, leans toward a liberal version of emancipation and may contribute to reinforce oppressive power structures rather than the opposite. The liberal version of emancipation that Adam condemns is the one that aims at preserving neutrality rather than alleviating oppression. Her position is clearly based on the situated and embodied knowledge along with standpoint developed by Haraway and Harding. Accordingly, the way by which feminist theory can be relevant to IS lies in demonstrating the intersection of structures of power and inequality, which produces hierarchies of knowers and knowledge, therefore making certain voices visible while others invisible.

3. METHODOLOGICAL ENGAGEMENTS

As illustrated in the previous chapter, feminist analysis has produced a variety of approaches to the study of science and technology. Even the most recent critique of computing as gendered professional and technical culture is characterized by different epistemological and political stances, from liberal approaches focused on equal opportunities and the structural processes that keep women out of technical fields ('leaky pipeline', 'glass ceiling', 'sticky floor') to those perspectives that emphasize the mutual shaping of gender and technology as well as the most recent ones that underline the entanglement of semiotic and material practices surrounding technology. Given these theoretical frameworks and analytic sensibilities, I have tried to put some of them into work through the engagement with two different field sites: (1) an historical analysis of the work carried out by the first female computer operators working at the ENIAC, the first electronic computer programmed for general purposes along with the study of some of the networks and initiatives committed to promoting more female presence and gender awareness in computing; (2) an ethnography I have undertaken in an Italian telecommunication company in which I have traced out the role of digital tools and materiality in the process of organizing.

In this chapter I shall illustrate the arrangement of such diverse methodological approaches and describe in more detail the two settings I have been engaged with. Lastly, I shall bring into focus the challenges that feminist thinking poses to methodology as far the articulation of research between the "field" and the "desk", the power implications of research positioning and ethical commitments are concerned.

3.1 Methodological bricolage

3.1.1 Women and computing: narratives, observations, and historical analysis

Behind the main analytic sensibilities — such as 'situated knowledge' and 'cultivating disconcertment' — informing my inquiries and empirical investigation, lies the critique of the traditional tenets of scientific knowledge such as 'objectivity' and 'detachment'. These assumptions, along with the alleged neutrality of technical artifacts, have been questioned through research methodologies that privilege a "proximal view" over a "distal" one (Cooper & Law, 1995; Giancola & Viteritti, 2014). A proximal approach invites the researcher to focus on objects of inquiry as not "taken-for-granted states of being" (Cooper & Law, 1995), but rather as outcomes of discourses, practices and processes of ordering and enacting (multiple) realities.

Against this backdrop, I have drawn on the narrative methodology employed in social research (Gherardi & Poggio, 2009; Czarniawska, 1998; 2004) to engage with storytelling and stimulate reflection and reflexivity about women's relationship with computing. As Gherardi and Poggio (2009) point out, narrative knowledge is a widespread research practice in feminist practice and theory for its ability to enact reflection, reflexive thinking, thus moments of learning. Reflection is conceived of as a practice able to make individual experience matter of analysis and assessment. The process of examining and re-examining personal experience allow actors to trace critical moments, contradictions and turning points so as to open the black box of individual trajectories.

On the other hand, reflexivity refers to ethnomethodological scholarship (Garfinkel, 1967) and has to do with "practices of accountability, observability and referability of social action" (Gherardi & Poggio, 2009, p. 55). Thus, it involves languages, symbols, narrative practices used to account for events and experiences in interactional contexts. In this respect, the process of narrating is not just an assessment of actions and occurrences, but it sets out the contexts for experiencing the relation with computer technologies in this case. Accordingly, narrating constitutes a transformative practice as framed by feminist critique since "It is an opportunity for individuals to acquire renewed projectuality and a more sophisticated ability to interpret and make sense of the events that they encounter" (Gherardi & Poggio, 2009, p. 56).

Against this backdrop, I chose to employ a narrative approach in doing semi-structured interviews with women working in IT and engaged in initiatives

committed to increasing the female presence in computing and technology work more in general. In doing so, I have followed Gherardi and Poggio's approach to narratology, thus stimulating reflection and reflexivity about women's experience and relation with computer technology. In this respect, I have to point out that my aim was not that of eliciting any essentialist and universal female standpoint, but rather I was interested in exploring experiences and viewpoints on computing education and careers of those women who openly unmask gender troubles in IT through their participation and commitment to networks and initiatives that address such issues. As some recent studies have pointed out (Balka & Smith, 2000; Misa, 2010; Abbate, 2012), if mechanisms of women exclusion from technical careers have been probed in great detail, we still know little about the experience of "those few" female practitioners who inhabit IT worlds. In this regard, the structure of the interview aimed at examining three essential concerns: (1) biographical notes and educational trajectories, (2) gender troubles, (3) personal attachment and feeling about computing. Additionally, I have enriched findings from interviews with field notes related to my participation to events organized by networks involved in the study.

This fieldwork is introduced by an historical reconstruction of the first female computer operators working at ENIAC, the first electronic computer programmed for general purposes (see Haigh, Priestley, & Rope, 2016). This study, as well as any accurate historical account of early digital computing era, has been crucial insofar as it unveils the prominent role of women as computer operators during World War II in the USA. Such an acknowledgement helps to problematize the current shortage

of women in computing as anything but the evidence of a technical, thus inherently masculine, domain; rather, it indicates that the professionalization and masculinization of computing was the product of historical contingency, intersections of new and traditional disciplines, and a gendered division of labor.

3.1.2 Studying organization through ethnography

Ethnographies are a rather common methodological tool and perspective employed in organization studies and STS. Significant examples in the first case are Gideon Kunda's analysis of the corporate culture of an American high-tech organization (2009 [1995]), Bruni, Gherardi and Poggio's study of gender and entrepreneurship in Italian firms (2005), Barbara Czarniawska's fieldwork in three European capitals to explore the phenomenon of "city management" (2002); among ethnographic studies in STS, notable cases are Bruno Latour and Steve Woolgar's anthropological investigation of the construction of scientific facts at Salk Institute (1979), Sharon Traweek's articulated description of the world of high-energy physics (2009), and Lucy Suchman's investigation of human-machine interactions at Xerox's Palo Alto Research Center (2007 [1987]). While these works present different empirical subjects and analytical concerns, they all put at their core the interest in understanding the processual character of organizing. As Bruni notices (2003), as methodological practice based on the observation, description and interpretation of ordinary processes or organizing, ethnography is both a research methodology (based on observation and description) and an interpretative perspective on the activity of organizing. Indeed, for many ethnographers organizations as such simply

do not exist insofar as "for ethnographers, 'organization' is any form of organized action" (Bruni, 2003, p. 7, my translation). Organization, therefore, is a social artifact made up of and enacted by practices, symbols, language, rituals, forms of control, technologies and material objects.

Given my interests in understanding how the relationship between feminist critique and IT can be investigated in lively contexts and ordinary practices of organizing, I chose to undertake an ethnographic study in an Italian IT company in order to directly observe and participate to such activities. From February 2014 to December 2015, I paid 28 visits to the company in which I have approached different people, groups, spaces, practices, and processes, participated to meetings, done interviews, shadowed actors (Bruni, 2003; Sclavi, 2005; Czarniawska, 2007). In doing so, I have mobilized my primary research interest, that is the focus on the role of technology, infrastructure and materiality (Suchman et al., 1999; Star, 1999; Latour, 1993) in the process of organizing. As other investigations with similar concerns have showed (Pellegrino, 2004; Bruni, 2005), questioning the agency of non-human actors as to the heterogeneous process of organizing unveils multiple and complex ways of ordering through practices, discourses, frames, styles, and repertoires (Mol, 2002). Additionally, ethnographic contributions from workplace studies and CSCW (Suchman et al., 2002) have questioned the very boundaries between the social and material insofar as they are, as Law and Mol argue (1995), relational effects, material distinctions, and matters of local performance. In this regard, Bruni suggests a shift from the symbolic-interpretative approach to ethnography to "ethnographic materialism" (Bruni, 2005).

3.1.3 Practicing methods as poaching

As illustrated in the previous chapters, this dissertation draws on an interdisciplinary body of knowledge (mainly STS and FTS) in order to discuss the relationship between feminist critique and IT. Such recourse to multiple analytic sensibilities becomes somewhat necessary given the polyphonic character of the analysis that a similar complex issue demands. This is true also for the methods I have interpellated to put analytic concerns to work. Ethnography, semi-structured interviews, and historical accounts have been in fact crucial methodological practices in order to bring the research questions into play.

David Silverman (2006) has called 'triangulation' the use of multiple methods and analytic sensibilities to render the heterogeneous character of the issues under scrutiny. In the so-called "qualitative research", the employment of multiple methods consists, for example, in combining interviews with observations, historical sources and statistical data. However, triangulation is not aimed at validation or achieving a comprehensive representation of the object of study, but rather it "is best understood as a strategy that adds rigor, breadth, complexity, richness and depth to any inquiry" (Denzin & Lincoln, 2000, p.5, quoted in Silverman, 2006, p. 292).

Perhaps, a more interesting way to frame the methodological bricolage of this study is close to the concept of 'poaching' that Michel de Certeau (1984) related to reading, and Czarniawska (2004) mentions with regards to the methodological discussion on how to deal with a field of theory and authors' texts. Briefly, in

challenging an ideological idea of ‘consumption-as-a-receptacle’, which would depict the reader as a passive receiver who assimilates texts and unreflexively reproduces its meanings, de Certeau argues that the reader brings to bear an inventive stance towards texts as s-he detaches them from their origin and creates new meanings. As de Certeau puts it: <<This misunderstand-ing assumes that "assimilating" necessarily means "becoming similar to" what one absorbs, and not "making something similar" to what one is, making it one's own, appropriating or reappropriating it>> (1984, p. 166).

In this study, “poaching different methods” has meant to borrow some methodological tools from different fields (ethnography from anthropology, historical analysis from history of technology) and to re-contextualize them for the purposes of this research. As far as the reliability of this research practice is concerned, I borrow from Czarniawska: <<The observation that the inspired mode of using other people’s texts is more frequent than the exegetic is not a proof of lax customs in academe: unless exegesis is the topic of a monograph, the inspired mode is much more relevant to the task at hand>> (2004, p. 121).

3.2 Women and computing: networks and campaigns

3.2.1 Women team up: unmasking gender blindness in IT industry

After my MA graduation in 2010, I worked for 15 months as writer for an Italian online newspaper called "Punto Informatico", which reports on emerging technologies, Internet, communication, law, business, security, and digital culture. During that experience, I often happened to cover news about gender themes in IT such as the shortage of women in IT industry, sexism and violence online, women representation in videogames, gender discrimination in IT companies, diversity and minority issues within technology industry. Given my interest in gender studies, which I started to cultivate during the university years, I thought that their deep and widespread roots in technological fields was definitely a phenomenon deserving attention.

When I began my PhD program, I embarked on doing desk research on gender and women issues in computing and I discovered interesting studies that certify the dearth of women in such realm. This corpus of research generally focuses on social, historical, institutional and cultural causes and mechanisms that prevent girls from accessing computing educational paths or induce female professionals to leave their careers (e.g., Balka & Smith, 2000; Misa, 2010; Abbate, 2012; Booth, Goodman, & Kirkup, 2010; Ensmenger, 2010). These studies thus demonstrate well through different methodological and analytical tools the processes that keep women *outside* computing domains.

However, what has interested me most about this literature were the accounts of the motivations, ambitions, expectations, and events that pushed women *inside* computing work, an aspect that somewhat finds little room in comparison with segregation and discrimination factors. I then decided to pursue this concern along my research by investigating the knowledge practices, political demands, and viewpoints on gender and technology of those organizations and networks that promote a greater female presence in the IT industry through different initiatives. I discovered a rather rich archipelago of international and local organizations made up mostly of women who dedicate part or full time to develop a number of actions – from seminars to hackathons, from workshops to laboratories, from bootcamps to classrooms – aimed at introducing, empowering and educating young women to computer science and its trappings. As far as my research is concerned, I have gotten the chance to attend some of these initiatives organized by the following groups: Girls Geek Dinner, Rails Girls, Ubuntu Women, Girls in Tech, Wister, Microsoft Pink Cloud, the NERD? Project. Some of these organizations are based outside Italy, but have multiple chapters around the world; others are Italian initiatives, still others – like Ubuntu Women – are basically online communities with local groups in different countries, which sometimes settle on physical meetings.

As far as methods are concerned, in this fieldsite I conducted nineteen semi-structured interviews with women aged 22 to 70 years with an educational background in computer science. They hold a range of positions as university student, PhD candidate, engineers, managers, consultants, academic professors. I

have also enrich the accounts drawn from interviews with five direct observations of events such as workshops, seminars and hackhatons. The choice of doing interviews relies on two main reasons: the high degree of informality of the associations they are involved in and the lack of time on my part made the option of embarking on a prolonged research activity like ethnography virtually unfeasible; but more than practical concerns, what has made me lean towards interviews has primarily been the need to access female histories in order to probe their biographies, frames of interpretation and ways of reflecting on their experiences within the computing domain. The narrative approach in social sciences and in feminist scholarship is by all means a widespread research method (Czarniawska, 1997; 2004; Gherardi & Poggio, 2009; Poggio, 2004; Cozza & Poggio, 2007). One of its main strengths lies in its efficacy in detecting different voices at stake. As we shall see in the following chapters, indeed, women interviewed construct different stories as to their biography, views on gender relations in computing field, their involvement in the work, and the ways in which they differ are crucial to apprehend dynamics of events as well as the intersection of social expectations and individual agency (Jovchelovitch & Bauer, 2000).

3.2.2 Why studying women?

In the foreword to the book titled *Crossing Boundaries, Building Bridges* (Canel & Oldenziel, & Zachmann, 2000) on the history of women engineers between the 1870s and 1990s, Ruth Schwartz Cowan argues that in most fields of study what is rare is inherently worthy of study; women engineers deserve therefore scholarly

attention given their scarcity. Moreover – Cowan keeps on saying – women engineers are an intriguing topic of investigation because of the type of work they carry out: from developing medications or foodstuffs on mass scale to maintaining bridges, roads and buildings to designing micro and large electronic systems. Engineering, as well as the whole range of technoscientific fields, plays a major role in regulating social life, and the variety of issues and concerns it brings to the fore makes it anything but dreary. A third reason why, according to Cowan, studying women engineers is an engaging task to take up is because of their bravery, as they, consciously or not, decide to challenge social norms about gender roles, institutional barriers and a professional culture commonly defined as male-based.

I found Cowan's insights rather truthful in enlightening the current condition of women studying and working in IT fields such as informatics, software engineering, computer graphics and so forth. According to recent national and international studies (Avveduto & Pisacane, 2015; She figures 2016), indeed, while there is a growing presence of women in STEM fields such as medicine, biology and biotechnology as well as in physics and chemistry, the increasing trend is less pronounced in engineering and computer science (Pearson, Frehill, & McNeely, 2015). Moreover, it has been proved that the number of women is even lower in some engineering subfields considered more masculine, such as mechanical, electrical, aeronautical, whereas other segments, like civil and environmental engineering, register an increase in the number of women (see Lewis, Harris, & Cox, 2007; Franzway, Sharp, Mills, & Gill, 2009). Despite the slightly general growing presence of women in technoscientific fields, women are not less discriminated

(Allegrini, Pellegrini, & Segafredo, 2015; Ceci, Ginther, Kahn, & Williams, 2015), and science and technology still are fields that add and confirm inequalities. Gender stereotypes, leaky pipeline, glass ceiling, sticky floor, work-family reconciliation are just some of the mechanisms identified to describe the reasons behind the lack of women in scientific fields

However, as Ellen Balka has sharply pointed out (2000), while the lack of women in computer science is well documented, surprisingly little data have been provided as to the factors that contribute to women's success in informatics. Likewise, few studies exist about educational programs and initiatives designed with the explicit aim to attract young women (a notable exception in this regard is Margolis & Fisher, 2003). The main trend in women and computing literature has thus been that of scrutinizing the persistent and ongoing gender and race divide, with less attention to the recognition and understanding of women's proactive and interventionist activities already underway. A similar focus is therefore critical insofar as it reveals how female scholars, students and professionals collaborate to make technological shifts and changes responsive and accountable to women and girls on their own terms. In saying so, I am not arguing for an essentialist viewpoint that envisions a feminine nature of computer technologies and computer work. Quite the contrary, the choice of studying women's experience aims at going beyond the cultural and ideological association between masculinity and technology, an assumption that is sometimes sustained even by feminist writers as Gill and Grint notice (1995). My intention, therefore, is that of unveiling how women relate informatics by articulating their own agency in terms of

reconfiguration and enactment of new practices and networks among contexts and disciplines that are not taken for granted, but always reworked. As the historical reconstruction of women behind ENIAC in the next chapter will point out, the choice of studying women's narratives would help precisely to disassemble the "semantic eclipse" (Jacques, 1996) that creates an overlap between a subset of hegemonic meanings and a broader set of them. At the same time, it will emerge that women's narratives present common traits regarding their experience in computer fields, but also different views on gender relations and the field itself.

3.2.3 The access: enrolling and being enrolled

Unlike the research in Passic TV, accessing these groups has been very easy and comfortable. I found great cooperation from the women I got in touch with as they demonstrated a genuine interest in speaking of the topics they care about, such as the gender question in IT, their personal experience at school and work, and their emotional involvement in informatics. Moreover, after early interviews I carried out, I verified what I had suspected at the beginning, namely that several women belong to more than one organization, that some of them participate to activities promoted by other groups, therefore that most of them know one another. It turned out that they were all glad to spend their time for interviews and that, during our conversations, they suggested me other people to contact.

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From: xxxxx xxxx <xxxxxx@gmail.com>
Date: Fri, 4 Dec 2015 18:22:41
Subject: Re: Intervista per ricerca di dottorato
To: Mariacristina Sciannamblo
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Ciao Mariacristina,
è un piacere ricevere la tua email, xxxx e xxxxxx mi avevano parlato del tuo lavoro, al quale sarei contenta di dare un contributo. Io la prossima settimana sono all'estero, e comunque in generale, come probabilmente ti avranno già detto, durante la settimana per me è problematico incontrarci perché lavoro molto lontano. Il weekend, però, sono a disposizione; se questo non ci sei va bene anche il prossimo o quando ti rimane più comodo.
Ti ringrazio molto e spero a presto,

Hi Mariacristina,
I am glad to receive your email, xxxx and xxxxxx told me about your work, which I would be happy to contribute to. Next week I am abroad, but in general, as you probably know, for me it's complicated to arrange a meeting on weekdays since I work very far from home. But I am fully available during the weekend; if this coming weekend you are not here [in Rome], it's OK to me to meet up next one, or whenever it's fine to you.
Thanks a lot, and hope to see you soon.

From: xxxxxx <xxxxxx.xxxxxxxxi@gmail.com>
Date: Wed, 11 Mar 2015 09:01:42
Subject: Re: Dottorato di ricerca su gender e computing - Intervista?
To: Mariacristina Sciannamblo

Buongiorno Mariacristina e grazie per aver pensato a me.
Sono molto felice di aiutarti, anche perché sia xxxxx che xxxxxxxxx sono persone di grandissimo valore, ne consegue la fiducia nella bontà della tua ricerca.
Io sono a xxxxxx praticamente tutti i giorni, organizziamoci per un caffè.

Good morning Mariacristina and thanks for having thought of getting in touch with me.
I am very happy to help, also because both xxxxx and xxxxxxx are people of great value, it follows the trust in the goodness of your research.
I am at xxxxxx basically everyday, let's grab a coffee.

From: xxxxxx xxxxxxx <xxxxxx@xxxxxxxxxxxxx.it>
Date: Tue, 28 Apr 2015 10:00:52
Subject: Re: Intervista per dottorato di ricerca su gender e IT
To: Mariacristina Sciannamblo

Buongiorno Mariacristina,
ti ringrazio per aver pensato a me e non mancherò di ringraziare anche xxxxx. Sarei felice e lusingata di poter contribuire portando la mia esperienza.

Ti lascio altri contatti:

Good morning Mariacristina,
thanks for thinking of me, and I will certainly thank also xxxxx. I am flattered and would be happy to contribute by bringing my experience.

I give you my further contact information:

As these email messages demonstrate, the selection of subjects to involve in research projects is not necessarily a product of careful decision-making on part of the researcher. Rather, it happened in a chain of events that were not fully controlled by myself, but came about in what it turned out to be a first indication of the practices and values that characterize most groups: collaboration and visibility (of themselves and the issues they care about). I realized, therefore, that in searching for people to enroll in my research, I was myself enrolled into a network that, in turn, opened up new opportunities.

3.3 Passic TV: humans and non-humans between STS and FTS

Having put the gender-technology relation at the core of my "desk" reflections, I came to realize that the choice of a setting in which to investigate such theoretical issue could have been inspired by the notion of 'technologically dense environment' (TDE) (Bruni, Pinch, Schubert, 2013). Such a discernment stemmed from a couple of significant events occurred after the beginning of my doctorate course (November, 2012), namely the encounter with my supervisor who introduced me to the STS world, and the STS Italia Summer School I attended in June 2013, which focused precisely on the understanding of TDEs. The study of STS literature (which I got the chance to taste at the end of my MA program in Communication) and the engaging environment of my first summer school allowed me to familiarize with and become interested in some of the main terms of this archipelago of knowledge such as 'materiality', 'infrastructure', 'sociomateriality', 'affordances' and 'scripts'. In fall 2013, then, I was looking for an organization that would present a technical infrastructure, sociomaterial practices, specific expertise, and, of course, gender relations to investigate. As anyone can easily assume, potentially any organization (research labs, hospitals, public administration, virtual communities, etc.) is made up of this kind of entanglement and I was myself aware that contemporary world is informed by 'technological forms of life' (Lash, 2001) and by an 'object-centered sociality' (Knorr Cetina, 1997). Given my background in Communication Studies, I hoped to find my research engaged in a familiar setting like an ICT organization, and so that has happened when my supervisor told me that one of the lecturers of my department worked also as project manager in a big ICT company in Rome. When

we approached him, we realized we shared some theoretical references and, above all, we have agreed to partake in a research project.

This paragraph introduces my first research field in an ICT company called Passic by illustrating some methodological issues that have affected my empirical study along its course, since the very moment I got in touch with my gatekeeper, Dario[6]. Such practical troubles pertain to various aspects – access, reaching people, lack of information – of the research and, as I have gradually perceived, they pointed to analytical matters that will be further developed in the next chapters.

3.3.1 Passic TV: a multi-located, ever-changing organization

Passic TV is an Italian company that develops an on-demand streaming TV service within the broader business of Passic Mobile. Passic Mobile is a branch of Passic Network, an Italian ICT company which provides telephony services, mobile services, and DSL data services. Its headquarter is based in Rome, and it has many branch offices in several Italian cities such as Milan, Turin, Naples, Catania. The company has several internal divisions, services and international partnerships. Passic TV, which is the focus of my research, is part of a broader network called Passic Entertainment, which includes other services such as Passic Music, Passic Reading, Passic Games and Passic Football. Given the rather complex structure of the company, I have reproduced it graphically:

[6] The names have been changed for reasons of confidentiality.

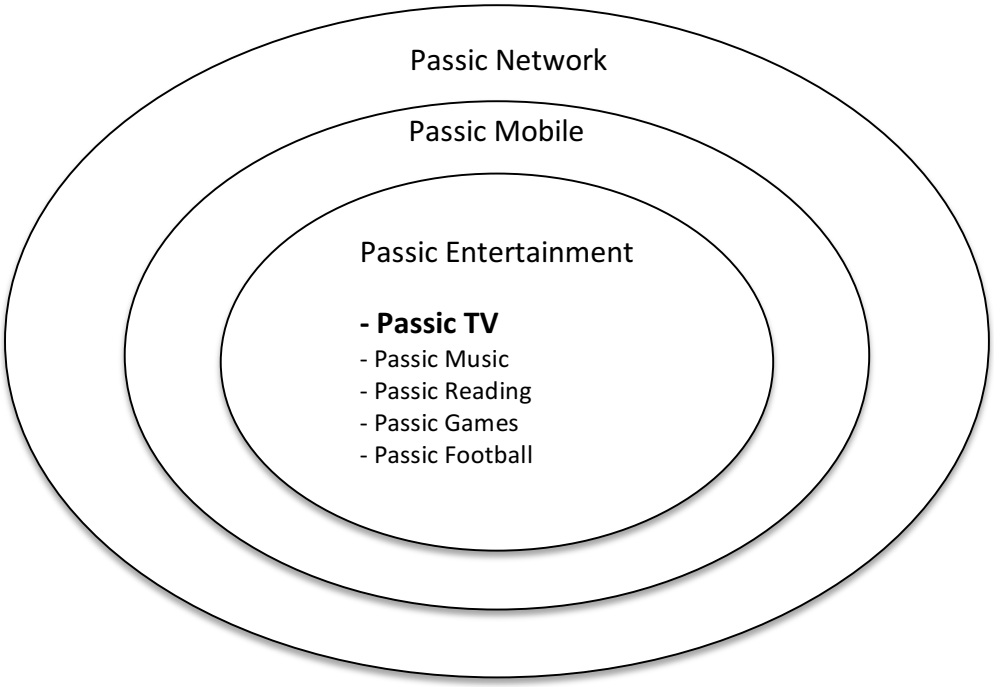

Figure 1. Passic's organizational structure

Activities involving Passic TV are mainly distributed across two offices in Rome: Via Loriano and Via Cischi. As we shall see in detail in *Chapter Six*, these activities pertain to a division of labor based on hierarchical and technical relations.

Given the compound structure into which Passic TV is included, its organization arrangement in terms of people, places, projects, and technical infrastructure if often subject to change. Such ever-changing environment engendered a sense of instability and chaos — as several people I met point out — that also affected my research with particular regards to the problem of access, as we shall se in the next section.

3.3.2 The access: a never-ending process of negotiation

Rome, January 28, 2014 - My first day of fieldwork,

> Today, at 2 pm, there is an important meeting in which the chief of Passic Entertainment will be outlining major plans and objectives for the year]in front of all the organization groups. Given the importance and rarity of general meetings such as this one, Dario, my gatekeeper, has thought it could be a good way to start my research. The appointment is scheduled at 1:20 pm, 40 minutes before the meeting starts, since he has also arranged a brief introduction of myself and my work to two women executives: the chief of Passic TV and the chief of Passic Entertainment. I have been given some background information about them, so I am somewhat prepared for the day, yet I cannot help but feel a sense of uneasiness, because this is my first day of my first ethnography and I am about to approach two executives without having in mind a clear design of my study.
>
> Since the office is quite far from my house, I have checked the directions out so as to be sure to get to the place on time. According to Google Maps, the trip to Passic office will take around 45 minutes with the scooter. I then decide to leave quite early at 11:45 as in Rome it is likely to get lost in unfamiliar areas or, at least, that has been my experience so far. If I get lost – I think – I will have time to work it out and be on time. Yesterday, Dario told me to the phone that the office is located in a side street close to a big road: <<when you get to Lariana, you will find a car dealership named Rinaldi; then you have to turn around at the first traffic light and take the first street on the right>>. Once I get to Lariana, I slow down so as to easily find the car dealership out. After some kilometers, I decide to make a stop and check directions online: the road is quite large and there is no one to whom I can ask for information as I usually do. The place seems quite close to where I am. I look at the clock, it's 12:45: I can make it. I drive for further 5 minutes, but there in no sign of car dealerships and I have the sense of having gone too far. I'm getting nervous, I don't want to call Dario because I don't want he thinks I'm not able to arrive just by myself, but it's 1:10 pm and our appointment is at 1:20 pm, so I have to ask him. In seeing my call, he thinks I am out of the office, but when I tell where I am, he replies I have gone too far. I have to find the way to turn around and go back to the city. When the appointed time comes, I am

> still on my scooter, finding the way to reach my field. I am more than annoyed. In years of job meetings, interviews, important appointments – I think — I have always arrived early. Today is the first day of field research of my PhD, I have to meet for the first time two people who are very influential for my work, and I'm late…
>
> I arrive eventually, around 1:40 pm, still in time for attending the meeting, but not for talking to the two women. I feel overtly embarrassed because I think that what has happened is a bad mark on my credibility and, above all, I feel ashamed for having put Dario, my gatekeeper, in a negative light with his bosses. (fieldnote)

I visited Passic 29 times during my fieldwork and the only time I was late was the first one. As the above note illustrates, the simplest difficulty in securing formal permission to do an organization study is the problem of physical access. This is an issue rather familiar for conflict research settings, which have been called also "dangerous fieldworks" (Hobbs, 2006), such as war areas, politically unstable countries, where participants are involved in violent activities, and researchers find themselves in the midst of ongoing conflicts. However, as I have come to realize in my first day of fieldwork, problems of physical access should not be taken for granted even in ordinary surroundings. As Czarniawska notices (1997, 2014), the problem of physical access is well known in organization research and it has nothing to do with age or experience. It nonetheless points to a critical issue of organizing, that is 'logistics', which require people and things to be in the right place at the right time. As I have gradually understood during my ethnographic journey, this is not a trivial concern in a multi-located organization as Passic is. Moreover, as I will be explaining in the next chapter, my actual access to the company has always been tied up with my status of "guest", meaning that I could get inside only when Dario

was inside as well, because my presence had to be authorized by someone from the company.

In reading the above fieldnote, I also acknowledge the feeling of vulnerability and fear of entering an "alien landscape" (Czarniawska, 1997, 2014). This is all the more significant as, according to outstanding ethnographic examples (see Reinharz, 1992), female researchers usually have an easier time than men in accessing mixed-gender field sites. Moreover, the case I have reported above is about a meeting with two women, a situation that was supposed to make me feel more comfortable on principle; after a more nuanced reflection, I have come to learn that my sense of uneasiness stemmed from the fact that I had to interact with two managers, more than with two women, in a moment in which I had not clear ideas on my research plans. If feminist and qualitative-based studies usually caution about the risk of objectifying people they study, the same issue on researcher's part is less scrutinized. As Czarniawska (1997, 2014) points out, indeed, the fact that fieldwork is major threat to the identity of the researcher is not a very common topic in discussing field methods perhaps because the feeling of "being threatened" is at odds with the image of a mature adult and a competent professional. What I did not know at the time was that such feeling of uneasiness was not a methodological bug, bur rather a field material and a source of knowledge, to become later an actual research strategy.

Being the process of access little treated by research accounts (Feldman, Bell, Berger, 2004), it is easy to assume that it ends when the collection of material in the field actually begins. This is also what I thought before starting my empirical

research as the formal agreement between me and Dario made me feel somewhat sure about the feasibility of the study. Although some seasoned qualitative researchers I talked to often asked me about the access to the field, I did not think of it as a critical issue. However, shortly after the beginning of my ethnography in Passic TV, I have started to recognize that 'instability' and 'unpredictability' would have been two distinctive words by which to pattern my research experience. The ever-changing environment in which I worked allows me to understand gaining access as a relational process (Feldman et al., 2004) and a form of emotional labor (Blix & Wettergrenthat, 2015) that include self-representation, building and nurturing relationships as well as dealing with rejections, uncertainties and breakdowns. The constant maintenance actions my fieldwork in Passic TV has required led me to join Bonazzi's observation according to which "difficulties in securing formal permission to do a study can be formidable and in some extreme cases can produce the only story there is (Bonazzi, 1995, quoted in Czarniawska, 1997, p. 33).

3.3.3 Dario: a gatekeeper, an informant, an epistemic partner

Without any doubt, Dario is the most prominent character of my ethnography in Passic TV. He is a white man in his early 40s, who works as project manager in Passic TV and lecturer in the social sciences department of my university. I came to know him thanks to the intermediation of my supervisor. The first time we met, I was in the early months of my desk research about STS and feminist studies of technoscience. I told him about my theoretical interests and my desire to couple

the empirical investigation on information technology with that on gender and feminist studies. On his part, he expressed his interest in engaging in a research project based on such themes and, in this regard, he gave me some general information about the team he worked with and the chief of Passic TV and Passic Entertainment, “both women”, he points out as an element of interest.

According to the *Sage Dictionary of Social Research Methods* (Jupp, 2006), gatekeepers for research in formal organizations are usually senior managers or executives within that organization’s hierarchy. “The seniority of such people means that they control both the researcher’s physical access to the organization and influence the degree of support the researcher is given subsequently by others within that organization” (Saunders, 2006, p. 126). Dario, therefore, has been my contact inside the organization, the one who vouched for me, granting formal access to undertake the research. However, unlike the commonplace, my gatekeeper was not a senior manager or an executive with the effective power to influence a high degree of support to my research by other members of the organization. Aside from the production group in which he formally worked and which showed full accessibility, I have gradually discovered that achieving other organization areas and positions was rather complicated. This depended not only on the limited support I have gotten for my research, but also on the mobile environment I was studying. This need to expand the gates Dario was able to open has been driven by the growing exigency of what Laura Nader has defined as “studying up” (1972), namely the study of the empowered people – engineers, managers, executives – in order to achieve a usefully contextualizing perspective. In

the struggle of gaining as much access as possible and in recognizing my gatekeeper's limited power of attaining a large support for my research, I then have come to realize how ethnography is a research practice that unveils and activates power dynamics at the same time.

But the role Dario has played within my research work in Passic TV has been more than that of a gatekeeper. Indeed, he provided a great amount of information and helped me to understand the organization processes, people to be interviewed, situations I witnessed and events I did not know about. During my stay in Passic TV, I often interrogated myself about his relevant weight in the investigation I have carried out and the related potential pitfalls. Is my research somewhat other-directed? Am I biased too much in doing this interview or in reporting that situation? These are recurrent quandaries I have faced during my days of fieldwork and afterwards, when I have examined data and constructed accounts.

At the same time, the significant relevance that the figure of Dario has had for my empirical research along with the acknowledgment that he also holds an academic position as lecturer in my department makes me conceive of the experience in Passic TV as a form of "collaborative fieldwork" (Konrad, 2012, p. 4). According to Konrad, indeed, collaborative models of research between countries, universities, and individuals have arisen as a response to emerging organization and epistemic shifts into global networks of research and learning. Knowledge intensification promoted by so-called "knowledge societies" have thus fostered collaborative forms of inquiries as intellectual associations and professional alliances, in which collaborators communicate across different disciplines and fields

through different languages, technologies and multiple forms of expertise. Of course, collaborative endeavors unfold issues of positionalities, relationalities, tensions and ambiguities that deserve an articulated treatment on their own. However, my research experience in Passic TV has echoed some of these issues such as, for example, how and to what extent academic expertise will be affected by emerging hybrid expertise traveling both inside and outside university as Dario exemplifies. I wonder how and to what extent research projects involving "interactional expertise" and "epistemic crossings" (Konrad, 2012, pp. 12-14) are changing the very concept of 'doing research'. How do translations among different expertise work? What and who is left out in such movements?

3.3.4 Doing fieldwork with different analytic sensibilities

Speaking of processes of translation among different forms knowledge and expertise, I have employed two distinct analytic frames — STS and Workplace Studies on the one hand, FTS on the other — in order to carry out the investigation of sociomaterial processes in Passic TV.

The reason why I have treated the analysis of the same field site with different, though overlapping, conceptual toolboxes speaks to two lines of inquiry: to trace out the agential role of material artifacts in the process of organizing on the one hand, and to discuss the agential character of theories on the other. In doing so, I aimed at showing how the analysis of materiality undertaken with traditional STS scholarship and with FTS poses different concerns, thus enacting multiple and different realities (Mol, 1999; Law & Urry, 2004; Barad, 2003). For example, STS and

Workplace Studies call into question the supposed neutral and passive role of mundane artifacts and demonstrate how things are instead “restless, critical, unstable, complex” (Latour, 1996: 296). On the other hand, feminist critique of technology has accounted for the political and ethical consequences of such realignments between human and non-human artifacts by addressing silent and invisible positions (Star, 1995; Star & Bowker, 2007) as well as highlighting the analytic advantage to unroll the analysis from such positions (Star, 1991; Haraway, 1997).

The employment of two different analytic frameworks has also served to account for the performative character of knowledge practices, which is one of the crucial concerns of feminist agenda (Gherardi, 2011). This issue brings about a twofold implication: the critical analysis of the ways by which knowledge is produced on the one hand, and the commitment to generating alternative practices of knowledge construction on the other. Narrating the field with alternative knowledge practices (STS and FTS) speaks precisely to these concerns insofar as it recognizes, following Barad (2007), that knowledge practices have not only material consequences, but also they enact specific worldly configurations through language, beliefs and material engagements in giving specific material forms to the world we grapple with.

3.4 Feminism confronts methodology

3.4.1 Orchestrating theory and empirical research

As previously explained, this research is driven primarily by some theoretical sensibilities that draw upon feminist perspectives on science and technology. As a consequence, the choice of empirical sites owes as much to practical convenience as to the analytical inquiries informed by this heterogeneous body of knowledge. Doing empirical research in two different fields, therefore, has proven to be a rewarding strategy to testify the fruitfulness of feminist critique with regard to issues concerning computing and IT.

The biggest challenge, therefore, has been that of orchestrating different research materials, instances and theoretical references while struggling with the temptation of making a comparison between the field sites. While, indeed, the possibility to systematize similarities and differences between the two case studies has been impossible and not even considered since the beginning, I indulged for a while in searching for valid evidences so as to be able to construct a tenable comparison, animated by the need to make order out of chaos. In other words, I was strenuously aspiring to achieve a distal vision while keeping a proximal one at play (Law & Cooper, 1995; Giancola & Viteritti, 2014). What I have realized when I confronted empirical materials was that the theoretical framework I was drawing upon provided convincing arguments for rejecting the procedures of comparison, without renouncing conceptual coherence and analytical resonance.

The concepts of ‘situated knowledge’ and ‘partial perspective’ developed by Haraway (1988), and then reworked by Marilyn Strathern’s ‘partial connections’ (2005 [1991]), challenge precisely the crafting of comparative knowledge seen as the root of objectivity (Haraway, 1988, p. 597). What is at stake in this vision is, in fact, the pattern of drawing relationships and boundaries among different knowledge as well as the fact that crafting knowledge is a practice that occurs in circumscribed domains and via the materiality of the knowing subject, which is the body (Gherardi, 2001; 2006).

3.4.2 Between “field” and “desk”: revisiting a classical distinction

In reflecting on the problems and tensions of the “gender-technology relation”, Rosalind Gill and Keith Grint (1995) stress the importance to study technologies in their own specific contexts of use, design and production. While, indeed, it is also important not to foreclose the possibility of constructing more wide-ranging theoretical understandings of the gender-technology relation, the major task is to illuminate them via empirical engagements with concrete phenomena. At the heart of such an interest, there is a sort of urge to overcome some theoretical formulations that, albeit helpful, may regard some circumstances as universal and transhistorical. Gill and Grint point to some examples in this regard, such as the “dilemmas of ideology”, the “problem with ‘patriarchy’”, the “tendency to functionalism” (1995, pp. 12-14-16), all of which refer to the risk to treat the gender-technology relation tautologically, without specifying historical limits, changes and differences. Such concerns can be related to the classical distinction in

social science research between the "desk" and the "field" (Czarniawska, 2014; Strathern, 1999), which emphasizes aspects and challenges of different moments in the research process, from dealing with theory, planning and designing fieldwork, collecting and analyzing data all the way to writing up and disseminating findings.

According to Barbara Czarniawska (2014), this iterative movement, from theorizing to description and from description – through analysis – to theory, is not only common, but also a highly recommended process among social scientists. In describing the character of ethnographic practice, Marilyn Strathern (1999) as well identifies a double location – the field and the desk – and the sense of loss the researcher has to deal with during the writing process, when s/he has to order and render the entire research experience. Although, as Czarniawska recalls, the moments of theorizing (at the desk) and collecting materials (in the field) are anything but separated from each other[7], Strathern (1999) describes the "ethnographic moment" as a moment of immersement, which is "simultaneously total and partial" (p. 1) precisely because the ethnographer's locations are to be seen as alternating, each offering a perspective on the other.

Looking from a feminist perspective, the question of how to articulate concrete links between overarching epistemological and theoretical issues (the desk

[7] In describing the practice of fieldwork within the grounded theory approach, Czarniawska claims to disagree with the expression "naturally occurring data" popular among ethnomethodologists, as far as the words 'nature' and 'data' are concerned. According to the Polish scholar, the concept of 'nature' has been largely disputed since the development of ethnomethodology. In her opinion, the phrase "spontaneously occurring actions and events" would suit better. Moreover, the word 'data' reminds to its Latin etymology, that is 'givens', something that is up for grabs, but they should be considered, instead, as 'takens', because it is the researcher that eventually makes the final decision about what to take and what not (Czarniawska, 2014, pp. 26-27).

stage) and the messy world of phenomena (the field stage) becomes even thornier given the interrelation between epistemological, methodological and ethical issues in feminist studies (Doucet & Mauthner, 2006). Nina Lykke (2010) has clearly outlined the reasons behind the multiplicity and diversity of methods in feminist studies. In the first place, there is the fact that it is impossible to talk about *one* feminist epistemology. As explained in the previous chapter, the landscape of feminist epistemologies is rather rich, and different approaches (i.e. liberal feminism, standpoint feminism, postmodern feminism, etc.) have called forth as many different views on phenomena and method to study them. In the second place, the very cross-disciplinary nature of feminist studies has in fact shaped a field in which multiple approaches and methods interfere. We can find feminist-informed research works across different disciplinary areas (education, labor studies, communication, medicine, law, etc.), thus they encompass a natural disposition "to experiment and create new synergies and unexpected connections moving across and in-between approaches and methods characteristic of different disciplines" (Lykke, 2010, p. 160). Accordingly, while it is by all means true that feminist research has produced more qualitative-based studies – whereof also this thesis aims to be an instance - thus far, feminist methodologists have claimed, on principle, an agnostic stance toward qualitative/quantitative methods, so that the Bardzell and Bardzell's (2011) call for more innovation in the area of quantitative methods becomes an opportunity not to be missed. Lastly, a third reason why feminist studies hold a pluralistic approach to the choice of methods relies on the innovative mark of the field, which, in turn, is the outcome of the critique of the

scientific and scholarly knowledge that has regarded the intersection of sex and gender as biologically or culturally determined, rather than changing and contextual.

In the light of these considerations, the distinction between the "desk" and the "field" becomes rather blurred within the framework of a feminist research project. As Lykke remarks (2010), there are no ready-made answers to the questions of method, which should only be assessed by considering the configuration of research interests, subjects and objects at stake in a particular research project.

3.4.3 The politics of research positioning

Research in STS has recurrently grappled with the account of the researcher position in the field since the enunciation of 'reflexivity' among the basic tenets of the Strong Programme (Bloor, 1976). In this regard, we can count a number of notable studies that present the researcher playing the role of "the stranger", both in ethnographic accounts (see Latour & Woolgar, 1986 [1979]) and historical investigations (see Shapin & Schaffer, 1985). Actually, the notion of 'stranger' has been elected as a sociological category since the seminal essay by Georg Simmel (2006) and the analysis by Alfred Schütz (1944), both conveying the idea of "the stranger" as someone who belongs to a certain group in terms of spatial boundaries, but not native of that group. The dichotomies of stranger/native, insider/outsider have also been foundational assumptions of classic anthropology, and then taken up by the Chicago School in sociology.

At the basis of such issues lies the relationship among researcher, subjects and objects of research, which, in turn, unveil different understandings of objectivity and knowledge production. Feminist critique has provided a compelling discussion of such polarities by putting into question the position of "the stranger" regarded as a typical gesture of scientific inquiry marked by detachment from the object of study and role differentiation from people in the field. Donna Haraway (1996) has identified such gesture in the figure of the "modest witness" represented in Shapin and Schaffer's account of Robert Boyle's experiments with the air-pump (1985). By means of an unconventional academic prose, she aligns the birth of modern technoscience with the raise of the "civic and modest man of reason", whose subjectivity lies in his objectivity, self-invisibility and transparency. While praising Shapin and Schaffer's endeavor to unveil the political and cultural nature of modern science, nevertheless Haraway remarks how they fail when they see gender as women instead of as a relationship among "clumsy categories" (race, lineage, class, religion) that help to establish what is "objective" and what is "subjective", what is "the outside" and what is "the inside" of science (Haraway, 1996, pp. 28-29). Examining also another "classic" of science studies such as *Science in Action* by Bruno Latour (1987), Haraway argues that sociologists of science have insufficiently appraised their basic narratives and tropes, and mistaken other narratives of action about scientific knowledge production as functionalist accounts just because they take into account preformed categories such as 'gender', 'race' and 'class'.

In challenging the stories collected within "the canonized version of the history of STS" (Lykke, Markussen, & Olesen 2000), Haraway claims that technologies adopted to make knowledge, including subject positions and the way of inhabiting such positions must be made visible and open to critical intervention. What distinguishes Haraway's diffractive critique and Harding's strong objectivity from other critical stances towards the processes of knowledge making in science studies such as that of reflexivity in STS (Woolgar, 1988a, 1988b) is the political commitment that rejects the position of researcher as "stranger" or "privileged observer" and opens up a critical inquiry about position and location, which is

> Not a listing of adjectives or assigning of labels such as race, sex, and class. Location is not the concrete to the abstract of decontextualization. Location is the always partial, always finite, always fraught play of foreground and background, text and context, that constitutes critical inquiry. Above all, location is not self-evident or transparent. [...] Location is also partial in the sense of being *for* some worlds and not others (Haraway, 1997, p. 37).

Haraway brings up the work of sociologist and ethnographer Susan Leigh Star (1991) as an interesting example of crafting, holding and making visible an analytical and critical position, specifically that of those who do not fit the standard. The reasons why the location of examining technoscientific phenomena from the point of view of those who are outside of powerful norms is compelling is because it can reveal multiplicities, layers of silence and invisibility, forms of violence and marginality that otherwise would not have been tracked down. These are the reasons why it is important that scholars reveal their "allergy to onions" and attend

the "*cui bono?*" question - to borrow Star's terms (1991) — that is to critically assess where to begin and where to be based by asking, for example, questions such as: what and who is this built for? Whose voices and visions does it comprise? Who is left out? Could it have been otherwise?

3.4.4 Ethicizing methods: thinking and doing research with care

As the above queries couch, there is a common thread in feminist critique that links epistemological, methodological and ethical issues together (Harding, 1987; Reinharz, 1992; Lykke, 2010). This is by all means an hallmark of feminist research practice as in social research such issues are usually treated separately from one another, and ethical implications *of* and *in* research are sometimes not addressed at all. However, if we think about the "performative" character of methods that this chapter illustrates, and that will be further remarked in the following chapters, an intellectual and research tradition which is closely tied up with a political project of emancipation and power asymmetries - as feminist studies are - cannot help but imply ethical concerns when it comes to facing the nitty-gritty "how-to" questions (Lykke, 2010). Law and Urry (2004) clearly articulate this problem when they point out that social inquiry and its methods are not only productive, in the sense that they help to enact social worlds, but, and for this very reason, they also have to interrogate themselves to some extent about what kind of worlds they want to help to make. A similar acknowledgement, therefore, marks out a shift from empiricist realism (the assumption that there is a single reality "out there" to be described given a context and purposes of the study) to *ontological multiplicity* (Mol, 1999),

namely the understanding that reality is *done* and *enacted* rather than simply observed. But what does thinking research through ethical issues means in practice?

A first, and perhaps obvious, consideration by which attending this question is that any research case, and especially field research, implies interactions with people and objects. These interactions can take place vis-à-vis through interviews, informal conversations, focus groups, shadowing, or can be mediated by electronic channels such as email, phone calls, VoIP calls, instant messaging. Far from being a "professional stranger" (Agar, 1980), the researcher becomes one-among-many actor at play, an active human participant that takes part to the *production* of meanings and events in the field. Accordingly, there are no epistemically privileged roles played by researchers or actors, but, as Czarniaswka (1995) remarks, the duty to listen to others' accounts lies in the fact that they are human beings just like us.

In this regard, it becomes crucial another issue usually emphasized by feminist and qualitative-oriented scholars, namely the need for researchers to build trusting relations with the people s-he encounters along his/her research experience. This is not to say, actually, that the researcher should become "friend" or have close relations with the persons s-he interacts with, because relationships among different actors depend very much on social contexts, object of study, professional roles, institutions to which they belong, and, as in any life circumstance, on human characters themselves. Reinharz (1992), for example, provides a variety of cases that demonstrate how the researcher can establish his/her credibility either by performing lack of involvement, impersonality,

academic objectivity or, conversely, by downplaying his professional status, behaving as listener and learner rather than researcher, so as to achieve a more egalitarian orientation. In this respect, it is interesting to note how the disclosure of research purposes and objectives can help to set up a productive dialogue and allow researcher's counterparts to become "co-researchers" Reinharz (1992) or "epistemic partners" (Holmes & Marcus, 2012) rather than just "key informants". Again, it must be underlined that these forms of creative relationalities (Konrad, 2012) are neither feasible nor always advisable, but depend on the research configuration and contingences.

Lastly, to return on the multiple ontologies where this section starts, postconstructionist feminist theorists such as Haraway and Barad have emphasized some methodological processes that aim at unfolding the mutual enactment of subjects and objects of research. According to Barad, for example, there is not a universal cut between subjects and objects, bur rather continuous intra-actions with each other, which generate provisional cuts and boundaries in specific research projects. Along similar lines, Haraway (1997) advances the concept of 'diffraction' (in contrast to that of 'reflection') as a thinking technology that helps to move beyond self-referential statements and create patterns of interference. In this regard, I recognize a similar move within an organization ethnography carried by Attila Bruni, Silvia Gherardi and Barbara Poggio (2005) in five Italian firms. In the methodological appendix of the book, they grapple with a self-interrogation of ethnography as a research practice. They describe the researcher's behavior during his days of shadowing entrepreneurs as follows:

> […] the fact that in our case the researcher's appearance and subjectivity triggered small incidents and to some extent upset organizational routine made the observation substantially different from that of 'a fly on the wall'. The researcher was able not only to observe a series of events but to activate others, constructing his shadowing as a situation negotiated by the people involved on the basis of diverse practices, and thereby providing the various actors involved (the researcher included) with opportunities to 'perform' their quotidianity. (Bruni et al., 2005, p. 214)

Although Bruni, Gherardi and Poggio frame their research endeavor within a critical reflexive stance, rather than a diffractive one, the above excerpt, along with the many references to the performative role played by the researcher and her toolbox, seems to fit nicely the diffraction figure insofar as it is regarded as the production of new patterns of difference in the world.

3.4.5 Writing research as ethico-onto-epistemic practice

What happens if we take Barad's call for ethico-onto-epistemology seriously? The reflection upon the material and ontological implications of knowing practices so far discussed invites me to consider the performative conditions of my own research practices. By acknowledging that the epistemic practices advanced in this dissertation are not merely "capturing" the world, but rather enacting it, it is important then to discuss the character of the cuts perfomed theoretically, methodologically and empirically, with the ultimate aim to highlight their ethical significance.

Brit Ross Winthereik and Helen Verran (2012) offer a compelling discussion of the crafting character of knowing practices, with a specific emphasis on ethnographic stories based on STS research cases. Drawing on feminist-informed notions, such as Strathern's partiality and Haraway's double vision, the authors grapple with the question of how to write ethnographic stories and make generalizations upon them. The main assumption behind such concerns is an ethical one, that is the acknowledgement of agential character of ethnographic stories, inasmuch as they are "*generative* for the people and practices that the stories are about" (Winthereik & Verran, 2012, p. 37, emphasis in the original).

In mobilizing the notions of 'partiality' and 'double vision', the authors seek to call into question the dualism between a traditional academic perspective that regards research as non-interventionist and its opposite, namely the engaged and interventionist research. Against this background, partial perspective and double vision suggest that the stories we write "are generative for *some of* the practices we study and for *some of* our own colleagues in social theory" (Winthereik & Verran, 2012, p. 38, emphasis in the original), and that other stories are possible.

It is precisely with these concerns in mind that I present here *other* stories related to my fieldwork in Passic TV. While they present important connections with the analysis advanced in the previous chapter, they differ from them at least for two reasons: they engage with further issues which have emerged from the field on the one hand, they are crafted and discussed in the light of feminist technoscience studies. In doing so, I attempt to engage with the broad question suggested at the beginning of this paragraph: what happens if we take Barad's call for ethico-onto-

epistemology seriously? Indeed, such understanding of writing stories as onto-epistemic practice solicits ethical concerns and, therefore, it matters for its power of accounting for — thus producing — multiple realities that differ in terms of power, knowledge, gender, location and visibility.

PART TWO
Women and gender issues in computing

4. WOMEN CONFRONT GENDER TROUBLES IN COMPUTING

What is the relationship between female professionals and practitioners in IT and computer technologies? How do women problematize gender issues in their technical field? What was the contribution of female labor in nascent digital computing? These questions inform the structure of this chapter, which focuses on the discussion of gender issues and the role of women in the computing field.

I shall address such topics from different analytic perspectives and methodological tools. In the first place, I shall propose a historical account of the early digital electronic computing era and the role of female labor in the rising industry. I shall emphasize the gendered division of labor behind the development of the ENIAC (Electronic Numerical Integrator and Computer) in the USA and the following development of computing as professional and technical culture rather biased by gender assumptions regarding the role of men and women in the labor market. Secondly, I shall present some statistical data on European and Italian level, which offer a macro view on the situation of gender equality in technoscientific fields (She Figures, 2016). These data allow us to assess the participation of men and women in scientific and technical occupations, with particular regards to the disciplines of science, mathematics, engineering, and computing. Starting from this

assessment, I then shall adopt a proximal vision (Giancola & Viteritti, 2014) to discuss a qualitative study on those networks and campaigns committed to promoting more female presence and gender awareness in computing and IT worlds. The structure and configuration of such initiatives is rather diverse and go from more informal organizational arrangements to a more systematic ones. More specifically, I have carried out direct observations of different gatherings (seminars, hackathons, workshops) and a set of qualitative interviews with female students, practitioners and professionals working and studying in computer fields.

Keeping in mind Wendy Faulkner's remark by which "just as one cannot understand technology without reference to gender, so one cannot understand gender without reference to technology" (Faulkner, 2001, p. 90), I shall seek to delineate the position and experience of women in relation to computer technologies (how they problematize gender asymmetries, what kind of discriminations, if any, they have undergone, how they have approached and how they relate to computing) as well as to investigate computer technologies in the light of women's accounts (troubling the alleged neutral character of computer technologies, how computer-related fields and technologies are genderized). In doing so, I shall disentangle the arrangement of symbolic, structural and identity-related (Harding, 1986) aspects that inform the relationship between women and computing.

4.1 The professionalization of computer work: a feminist-informed historical account

4.1.1 Where are the women? The feminization of labor in the nascent digital computing

The shortage of female workforce in IT industry and education is increasingly becoming a sensible issue, concerning both academic scholarship (see Margolis and Fisher 2002; Misa 2010; Abbate, 2012) and policy makers[8]. In order to investigate the profound roots of this phenomenon, it is important to go back to the early digital electronic computing era and to look at the role of female labor in the rising industry.

There are several historical studies that have pointed out the prominent work of women in computer industry, both in the USA and UK. In an essay eloquently titled *When Computers Were Women*, Jennifer S. Light (1999) engages in retelling the development of the first general-purposes electronic computer, the Electronic Numerical Integrator and Computer (ENIAC), by shedding light on the large amount of women that worked as proto-programmers, very close to those engineers regarded as pioneers in the history of computing such as J. Presper Eckert and John W. Mauchly. The main thesis advanced by Light is that the historiography of computing and computer labor has repeatedly dismissed the presence and the value of female work, fostering, that way, the popular image and belief of programmer as a male job. However, a closer look at the dynamics that animated

[8] For a critical analysis of the term 'Information Technology', see Kline 2006.

the nascent computing industry during the wartime brings up more nuanced questions regarding the employment of women: what is the nature of work undertaken by female employee at the time? What was the perception of female labor at the beginning of computing industry? What were the effective conditions behind the high number of women employed in computing careers? In addressing these queries, we can realize the pervasiveness of gendered assumptions and practices in computing industry, able to shape the nature of its expertise, organization of work and the purposes of computer itself.

The outbreak of World War II engendered important changes in the US job market since male workers were drafted into the army. Women were encouraged to apply for technical jobs, mostly concerning the assistant level. As Light underlines, in fact, aside from women with a Ph.D. degree, the rest of female workforce was intended as temporary, without any chance to climb up the job ladder. In *Recoding Gender Women's Changing Participation in Computing*, Janet Abbate (2012) provides a reliable account about the early women programmers, remarking that the fundamental reason why women came to staff the first electronic digital computer was the lack of male manpower due to the war. It was just a contingency indeed, with the understanding that women would vacate those positions after the return of men, so as to restore the traditional gendered division of labor. Labor patterns in scientific and clerical occupations are, in fact, at the base of the paradox that several scholars have recalled as characteristic of the role of women in early computer jobs (Light 1999; Abbate 2012, 2012; Payette 2014). The paradox consists in the complexity and degree of innovation conveyed by women's

work and the tendency from higher hierarchies and media to depict the same jobs as “unprofessional”. Although the members of the female workforce hired within the ENIAC project were not even recognized as individual identities, but commonly known as “ENIAC girls”, they took on tasks that demanded high level of mathematical skills and, at the same time, they were downgraded as “subprofessional” (Light 1999). Although the ENIAC was designed to take over scientific calculations carried out by humans until then (Grier 2005), it was necessary to provide a certain amount of human labor as far as programming equations into the machine was concerned, a task undertaken by those human beings now called ‘operators’. They mainly work on ballistic studies with desk calculators and differential analyzer to program, handling complex tasks related to machine’s circuitry, logic, physical structure and operation. As Light underlines, the ENIAC project comprised two parts – hardware and software – clearly framed according to gender patterns: working with hardware was considered a men’s job, whereas software programming was usually undertaken by women and regarded as a secondary, clerical task.

The mismatch between the actual work performed by women and the terms that employers and media coverage used to categorize it is one of the most controversial issues that is worth deepened, not only to reinstitute fairness into historical analysis, but also to provide a more nuanced understanding of sociotechnical processes, such as the gendered division of labor and the creation of specific expertise whereby the actors have constructed the technological frames (Bijker, 1987) related to the nascent electronic computer. In an article published in

1996 in the Annals of the History of Computing, W. Barkley Fritz reports the stories of the women behind the development of the ENIAC between 1942 and 1955, spanning from the wartime to its fully usage, through the period of its design and conversion. Reading the direct accounts of the female protagonists who participated to the development and launch of the "machine that changed the world" (Fritz 1996, 13), as media reports depicted the birth of the digital computing era, is rather interesting for acknowledging the historical circumstances that led to the design of the ENIAC, roles and hierarchies in the workplace, career paths for men and women as well as the gendered material practices and knowledge behind the hardware and software of the computational machine.

As several scholars recall (Fritz, 1996; Light, 1999; Abbate, 2012), the original team at work on the new project comprised six female coders: Kathleen McNulty, Frances Bilas, Betty Jean Jennings, Elizabeth Snyder, Ruth Lichterman, and Marlyn Wescoff[9]. Their stories had slightly different traits as to their backgrounds, but also some common points such as, for example, the refusal to teach mathematics in secondary school or to do repetitive calculations for insurance companies as well as their excitement for programming and being part of a novel adventure[10]. They were all been hired by the Moore School of Electrical Engineering of the University of Pennsylvania, where they worked with the differential analyzer and desk calculators

[9] As Nathan Ensmenger (2010) notes, the ENIAC girls are widely considered the first computer programmers, but, in the 1940s, they worked as coders, meaning that they basically translated into machine language the higher formal mathematical language developed by male scientists and engineers.

[10] As emerged from the direct accounts (Fritz 1996; Abbate 2012), the most common occupations for women with a college degree in mathematics were teaching in high school or work as actuary in insurance companies.

to compute trajectories for artillery firing tables. As they referred (Fritz, 1996), initially none of them knew about the new project despite the fact that they were required to undertake complex tasks, improve their theoretical knowledge and work many hours per day. Moreover, their occupation as computer programmers was considered "SP-4", namely as a subprofessional civil service grade. It is worth quoting the words of Kathleen McNulty, describing the work with the ENIAC:

> Operation included setting up the boundary conditions in the integrators, repairing or replacing the strings and bands on the torque amplifiers, guiding the arbitrary functions from input tables, and punching out the results of the calculations at specified times and at summit and ground. These two men and a young woman trained Fran [Frances Bilas] and me as operators for the differential analyzer, so that in a short time we were able to take over a work shift. We worked from 8 a.m. until 4:30 p.m. for two weeks, then changed over to 4 p.m. to 11:30 p.m. for two weeks. (Fritz, 1996, p. 16)

As clarified by these accounts, the nature of work undertaken by female employee required a sort of knowledge and abilities never seen before that time, made up of mathematical analysis, logical reasoning, but also topics outside the math curriculum such as numerical integration (*ibidem*). The need of an unprecedented and interdisciplinary expertise to set up the new machine went along with the sense of an interesting and unknown adventure for all the operators at work on the ENIAC. Indeed, when the young women moved to the Moore School in Philadelphia, the project was classified, so that only officers were aware of it, requiring trust and commitment more than a specific competence. As Betty Jean Jennings (Bartik) recalled:

> […] an announcement was made that APG was recruiting what would later be known as coder/programmers for ENIAC, a new machine being completed at the Moore School. Anyone who wanted to apply could go to a meeting at the Moore School. I had no idea what the job was or what the ENIAC was. All I knew was that I might be getting in on the ground floor of something new, and I believed I could learn and do anything as well as anyone else. I went to the meeting. There must have been a dozen or so of us. We were told very little about the ENIAC because it was still classified. Each of us was called in for an interview with Herman Goldstine and Leland Cunningham. Dr. Goldstine was the BRL liaison officer with the ENIAC project, and Dr. Cunningham was an astronomer from APG. They asked a few questions, and I remember Herman asking me what I knew about electricity. I said I had had a course in physics and knew E = I/R. He replied what he really wanted to know was, Are you afraid of it? I replied that I wasn't. His wife, Adele, then came into the room and called me by name. (*ibidem*, p. 19)

After recruitment, the new personnel spent some time at APG where they learned how to work with the various punch card machines such as tabulator, sorter, reader, reproducer, punch, and how to set up the control boards. This kind of training was prescribed by the situated technology of scientific problem-solving that ruled the function of the machine at the time, before the introduction of high-speed electronic calculators. At the base of the ENIAC's hardware, indeed, there were function tables that contained general mathematical solutions to be computed (by performing tricky arithmetic operations) so as to generate accurate ballistic data helpful to some of the US World War II activities such as the Manhattan Project.

Although the female labor involved tasks with high degree of innovation, women were considered as mere operators, executors of engineers' instructions and, at the beginning, kept in the dark about the entity of the project. Nevertheless, they quickly became very skillful in programming, learning how the new machine worked through logical diagrams as well as trials and errors (Light, 1999). Thus, they

acted as knowledge producers even though their status and role prescribed a subaltern position with reference to male engineers and officers. This gendered division of labor, determined by an "idiom of sex-typing" (Milkman, 1987, quoted in Light 1999), suggests anyway that organizational hierarchies and a severe demarcation between knowledge and execution did not reflect the way the computer was designed, especially with regard to its double configuration of hardware and software. The close relationship between the machine's physical structure and abstract operations that make it work, after all, was already clear with the differential analyzer that characterized the analog-computing era. The story of the development of the analyzer carried out by Vannevar Bush and his colleagues at MIT (Owens, 1996) points out how improvements made on hard components (shafts, discs, tables) were associated to as many refinements in mathematical calculations, just as the programming of the ENIAC assigned to women required a complete understanding of the machine's design controlled by men[11].

After the presentation and public demonstration of ENIAC in 1946, many female programmers retired to raise a family, whereas those who chose to hold the job kept on working in subprofessional roles, away from those professional trappings (Ensmenger, 2001) that will emerge in the following years.

[11] The job of programming required skills in trouble-shooting, that, in turn, involved the knowledge of both the application and the machine.

4.1.2. From clerical work to poetry: traces of transformation in computer programming

As we have seen in the above section, the early era of digital electronic computing was informed by a strict division of labor, with men undertaking design jobs that involved mostly hardware components, and women carrying out operative task with software applications. No one could ever expect that programming would have been regarded as a "black art" (Ensmenger, 2010, p. 27) over the two decades after the introduction of the electronic computer to the world. This paragraph puts precisely the 1950s and the 1960s under scrutiny, regarding them as years characterized by a fast growing computing industry and a parallel uncertainty regarding professional roles and expertise belonging to it.

The idea of 'black art' recalls the concept of 'black box' (see Winner, 1980; Pinch, 1992), namely something that lacks of transparency, whose components and functions are difficult to detect clearly. As the stories of ENIAC girls remark, the traditional division of labor, which implied a clear demarcation between clerical and intellectual tasks, did not work with the design of the new machine insofar it prescribed new paths of organizational management and new job profiles. These issues echo in many respects the sociotechnical dynamics that Wiebe Bijker and Trevor Pinch (1984) describe with regard to the design and development of the bicycle. By illustrating how different paths of technological development have been shaped by the demands of different social groups, diverging interpretations and rhetoric, technical constraints as well as social and historical contingencies, they solicit to frame the emergence of technologies as a "process" rather than "an

isolated event" (Bijker & Pinch 1984, p. 416). Moreover, it is not simply the different interpretations assigned to the artifact by relevant social groups that matter, but also how different uses are implicated in the design and re-design of the artifact itself. Looking back at the dawn of commercial electronic digital computing industry with these analytical lenses, we can understand, for instance, why programmers were able – often more than engineers – to scrutinize the vacuum tube technology of the ENIAC as well as its program. Indeed, the interpretation of the machine provided by designers often struggled with the use and knowledge programmers developed along their work. In this respect, there are a few lines from Betty Jean Jennings' account about the tests made before the public demonstration of the ENIAC in February 1946, that are worth being mentioned:

> The night before the demonstration, the trajectory program was running perfectly, *except* it didn't stop computing when it was calculated to hit the ground. It kept going. Betty [Holberton] and I checked and rechecked everything until about 2 a.m. During the night it came to Betty what was wrong. She came in the next morning and flipped one switch on the master programmer and the problem was solved. (Fritz, 1996, p. 21, emphasis in original).

This passage is rather eloquent about the strong tie between software applications and hardware components, which, in turn, defined the functioning of electronic calculators integrated rather than divided into independent technical functions and clerical tasks. Besides, it is worth noting the debt that, at the time, computing owed to electrical engineering before computer science would take over it, sanctioning

"an *explicit* division" of hardware and software processes[12] (Ceruzzi, 1989, p. 273, emphasis in original).

Although the new information industry benefited from a great commercial expansion, the computer programmer continued to occupy an uncertain position as a novel species of professional profile. If, on the one hand, there were thrusts towards emancipating analytic tasks from clerical and low-status work by introducing the distinction between programmer and coder, on the other hand the local and crafty nature of programming practices was undeniable. Anyway, as Nathan Ensmenger (2010) points out, gender patterns still played a significant role in downplaying programming profession, defining a rather clear correspondence between the marginal, clerical work and the employment of female coders. The question of status and identity of computer programmers was quite pressing for the nascent information industry along with doubts about the training – thus clear criteria of recruitment – computer employee had to present in order to adequately face the various challenges the new machines brought up.

By the mid 1950s, a new conception of programming as art developed and paved the way for the tensions between different computer programming cultures that would have appeared later. During this period, computer programmers had to deal with hardware's limitations and mathematical analysis, which required several compromises between speed and accuracy of operations. Given these technical

[12] According to Paul Ceruzzi (1989), electrical engineering and computer science dominated computing activities in different stages along 40 years. Between 1940 and the early 1950s, the technology of electronics supported the feasibility of Babbage's concepts of automatic computing machines, whereas, between 1955 and 1975, computer science promoted the digital approach into computing.

conditions, people at work on computers developed a peculiar type of expertise that combined analytic procedures and individual creativity. This blend of imagination and high precision led Frederick Brooks (1995) to juxtapose the figure of programmer to that of poet: the relationship between conceptual structures (the poet's imagination) and the code (the poet's words) are a matter of "magical incantation" and "perfection", more than of mechanical operations. The novel rhetoric surrounding computer programming solicited managers, like Brooks, during the 1960s to rethink conventional management techniques in the light of the new organizational requirements demanded by the nascent computer profession[13]. What is most significant of the poetry metaphor is the unprecedented central role assigned to software programmers within the production process and the consequent effort for managers to couple industrial demand and the creativity of programmers/artists.

Despite the fact that programming was meant as a "black art" by industry and technical literature between the 1950s and 1960s, the conformation of expertise and job requirements still remained hazy, wavering from those who emphasized craft techniques and situated knowledge, and others who used these features to denigrate the job, highlighting, conversely, the intellectual and scientific sides of the emerging profession. As we are going to see, in fact, these opposite views became apparent shortly afterwards, with the development of computer science. What was evident, even at that time, is that gender patterns were taken on from both the positions in order to denigrate the counterpart.

[13] Brooks became manager of IBM Operating System/360 in 1964, which was the software part of the larger System/360, designed to perform the complete range of applications.

4.1.3. What is a computer programmer? Labor practices and rhetoric on professionalism

The main benefit of using gender as analytic category in the study of science and technology lies reasonably in the demand to look at not only quantitative data that document the scarce presence of women in computing fields, but rather to employ feminist analysis so as to highlighting the process of "masculinization" of the profession. As Thomas J. Misa remarks: "surprisingly, not enough is known about how and when and why the gendered culture of computing emerged" (Misa, 2010, p. 8). Thus, keeping masculinization and feminization – then framing gender relations as social constructions and dynamic processes – on the same footing means rather to problematize the overlap between a subset of hegemonic meanings and a broader set of potential meanings, an operation that Roy Jacques (1996) has termed "semantic eclipse"[14].

At the beginning of the 1950s, a pressing issue started to threaten the growth of commercial computer industry, namely the increasing shortage of computer programmers flagged all over (see Ensmenger, 2010; Abbate, 2012). The need to recruit new workforce inevitably brought to the fore very contentious

[14] As Jacques observes: "In a lunar eclipse, observes on Earth see a small body blocking the view of a much larger one. In a semantic eclipse, a relatively small subset of meanings comes to block sight of a broader set of potential meanings. For instance, when a mode of rationality normative to Western culture, masculine behavior, and the modern era is simply called rationality, the only category remaining for the reasoning of other cultures, women, and other historical periods is *ir*rationality or *non*rationality. Only a small area of the domain of rational behavior is visible; the rest is eclipsed by it." (1996, p. 159, emphasis in the original).

questions about the forms of expertise and training, labor organization and cultural values surrounding the nascent profession of programming. At a closer look, we can see that professional requirements and technical standards set up to build a new organizational and technical profile (the computer programmer) are laden with gender assumptions regarding female labor and the identity of the profession under construction. For two decades until the early 1970s, indeed, the debate over programming methods involved a struggle among different meanings, metaphors and ideas to define the programmer's professional and social identity.

According to Janet Abbate (2012), two particular visions of the profession at the time – automatic programming and software engineering – are crucial to understand the process of masculinization under construction. The introduction of the first experimental compiler by Grace Murray Hopper, and the consequent debate over *automation* in computer programming, brought about two opposite views about the configuration of the professional identity[15]: there were those who believed programmers would have been deskilled (even replaced) on the one hand, and others who thought automation would have empowered programmers. Different, relevant groups – technicians, managers, users – held these positions according to their own, often conflicting, interests, which, in turn, were influenced by the sex of the worker. As Abbate suggests, indeed, what is important to highlight

[15] The first modern automatic programming system, called A-0 and written by Hopper at UNIVAC, allowed to considerably reduce the time to execute a program in a computer machine. Technically, the compiler took advantage and improved those reusable portions of code – called subroutines – by translating them into a program in machine code. This notable progress paved the way for the development of the first widely general- purpose programming language, FORTRAN, developed at IBM between 1954 and 1957 (see Ensmenger, 2010; Abbate, 2012).

with regard to the automation debate at the time is the weight of gender and labor dynamics, so that, for instance, framing programming as a subprofession would have meant to associate it with female workers. Even the supposed software crisis occurred in the 1960s and the raising of the software engineering method take different meanings if we look at the conflicts among different ideas of programming as a profession. Both Abbate (2012) and Ensmenger (2001; 2010) provide enough arguments to sustain that:

> Insofar as the software crisis existed at all, it was neither a distinct event nor a coherent description of prevailing conditions in the industry. It may be better viewed as an all-purpose complaint that reflected inflated expectations, labor tensions, and gendered assumptions about who could do programming and how they should behave. The crisis rhetoric also provided a rationale for those who wanted to change the direction of programming. (Abbate, 2012, p. 96)

> Like the "worldwide shortage of information technology workers" of the current era, the "acute shortage of programmers" of the 1960s was about more than a mere disparity between supply and demand. The problem was not so much a lack of computer specialists per se but rather the lack of a certain kind of computer specialist. Teasing apart just what that certain kind of specialist was supposed to be goes a long way toward understanding the larger social and political context of these debates. (Ensmenger, 2001, p. 70)

These two observations are rather remarkable, not only because they call into question the reasons behind the crisis, going beyond the acknowledgment of numbers, but also because they solicit to take on the question of labor shortage and recruitment in IT industry nowadays under different terms.

In 1968, the North Atlantic Treaty Organization (NATO) sponsored an international conference where to discuss about software programming. In that

venue, various communities were invited to claim their own concerns on the issue. According to Sandy Payette (2014), the divarication between two different interpretations about the status of the profession can be embodied by the figures of Grace Murray Hopper and Edsger Wybe Dijkstra. The former is famous for having written the first computer compiler at Remington Rand, whereas the latter is known for having won the Turing Award and set up computer science as an academic discipline. Their training, intellectual background and ideas clearly marked out different attitudes to computer programming and beliefs about its future. If Hopper held up software programming as an applied knowledge, connoted by pragmatism, urgency, opportunity, and collaboration, Dijkstra believed in a change of paradigm so that he strongly concurred to reframe programming as "software engineering", recognizing it as an "intellectual challenge" (quoted in Payette, 2014, p. 67), with the same dignity of art and science. Such positions, far from drawing just two different assessments and uses of the machine, outline divergent economic interests, labor organization and practices as well as public acknowledgement and prestige, all aspects which are, consciously or not, biased by gender stereotypes. The first clear evidence of this is the absence of women at the NATO conference, notwithstanding their prominent role in the early computing era both as practitioners and knowing subjects; the absence of Hopper herself at a conference sponsored by NATO is quite meaningful, as Payette suggests, given her leading role in the US Navy. Moreover, following the various works on the relationship between gender and language (see Wodak, 1997; Walsh, 2001; Weatherall, 2002), it is fundamental to investigate how discursive practices are mobilized in order to

produce and reproduce gender configurations on the one hand, and how gender constructs are functional to build a cultural/technical hegemony by relevant social groups on the other[16]. With regard to the co-construction of gender relations and computer programming, there is a passage about Hopper's work from a Dijkstra's speech, which is by far eloquent:

> Captain Hopper spoke officially about "Programming Languages"; her *[sic]* real subject was how she had acted as midwife to COBOL and she talked more about the Pentagon and the U.S. Navy than about programming. (Quoted in Payette, 2014, p. 69, emphasis in original)

The attempt to criticize, if not to downplay, Hopper's contribution to programming through a gendered language is rather apparent insofar it recalls the classic division between productive and reproductive labor illustrated by feminist and gender analysis on labor (see, among others, Schwartz Cowan, 1983; Piccone Stella & Saraceno, 1996).

Furthermore, as Abbate points out (2012), the rise of software engineering sanctioned at the Garmisch conference has to be intended more as a change in the guise than a substantial reform of computer programming. The term 'engineering', indeed, was brought up to sustain a novel structure whose components (abstraction, modularity and conditional loops), in reality, predated it. The reference by Abbate to the "unspoken ideas about which gender could best elevate the practice and status of programming" (2012, p. 103) echoes in many respects the

[16] With the term 'cultural hegemony', I refer here to the intellectual thinking of Antonio Gramsci (1948/2007), further developed by Stuart Hall (1987) within Cultural Studies. Unlike 'domination' and 'ideology', hegemony needs consensus from popular groups to be effective, its power is temporary and constructed through the intervention of social, political, economic, cultural and media structures.

attempt by Misa (2010) to frame the gender gap in computing by arguing in favor of gender biases encoded in professional culture rather than formal discriminations. That the high presence of women – although in deskilled labor positions - was intended as a temporary opportunity is not only demonstrated with reference to the wartime, but also during economic crises as emerged from Marie Hicks' analysis (2010) on computerization in the British public service. After the economic troubles and labor shortage in high-tech industry in the mid 1960s, which favored a nearly equal treatment for women and men entering computing workforce, young female computer operators resigned due to low payments and bad job conditions. The Royal Air Force, then, decided to hire middle-aged married woman as machine operators since this kind of job profile was supposed to not have career ambitions and particular economic demands; thus, women were perceived not to be the best candidates for computing careers. On the other hand, private companies hired men as machine operators "because they offer a complete career to such people, and partly, as was said earlier, because it is felt that the computer field is generally a young man's domain. ... The young man seems to represent the 'best bet' if career opportunities and financial rewards are satisfactory" (quoted in Hicks 2010, p. 108). Therefore, technical skills were not a matter of concern for hiring women; the issue at stake regards, instead, the social expectations about female workforce, considered as temporary and not suitable for professional careers within computing industry. Not "the best bet", indeed.

4.1.4. Conclusion

In discussing the issue of 'heterogeneity' related to the processes of stabilization and standardization, Susan Leigh Star (1991) keenly remarks how power belongs to those able to impose the metaphors that shape the worlds we live in. Accordingly, reading the historical circumstances related to the birth of computing as a professional expertise and labor organization through feminist scholarship (see Faulkner, 2001) means not just to highlight the contribution of women to technological development, but rather to shed light on the gendered nature of interests, beliefs and rhetoric upheld by different communities of practices (Lave & Wenger, 1991) in computer work.

In this section, thus, I have attempted to provide a picture of the nascent digital computer fields as not just a matter of inventors and individual enterprises, but rather as a tangle of social and political assumptions on labor, gender and technology. I have started by presenting the introduction of the ENIAC through the stories of women at work on software components. Even at the time, in fact, the hard/soft split, well articulated by Paul Edwards (1990), was an ideological construct useful to draw a demarcation between the analytical thinking embodied by male designers at work on hardware, and the mechanical work carried out by female operators. In fact, a closer look at the nature of work the ENIAC girls undertook demonstrates how the constructed image of computer machine as divided into hardware and software components, although being inadequate even from a technical point of view, served as a good argument to shape the configuration of the computer professions.

Between the 1950s and the 1960s, a novel metaphor of computer programming as a “black art” came out to improve labor conditions and general reputation of programmers. It concurred to define quite clear boundaries and tensions among programmers, computer scientists and managers, becoming evident with the recruitment practices (aptitude tests and psychological profiles) developed to face the software crisis emerged at the end of the 1950s on the one hand, and during the conference sponsored by NATO in Garmisch on the other. This venue gave birth to the software engineering approach, which, as explained in the third paragraph, was, more than other things, an attempt to gloss the image of programming profession without getting through real changes. As emerged from the challenge between the growing computer science and an applied approach to computing, the attempt to strengthen the influence of scientific thinking was marked out by clear conceptions about the gendered division of labor, which assigned women to domestic duties rather than to professional careers.

The aim to frame the issue of ‘professionalism’ in computer industry within feminist perspectives on science and technology speaks also to the solicitation (Haigh, 2015) for providing further analyses that put the history of computing in conversation with the history of computer science. As compelling case studies have pointed out (see Lerman *et al.* 2003), in fact, the use of gender as analytical tool – and not as a mere variable – in the study of science and technology invite scholars and researchers to interrogate not only the boundaries between men and women, masculinization and feminization, but also those dichotomies, such as hardware/software, practice/knowledge, skilled/unskilled, user/producer, which

have long regulated – and still they do – discursive and material practices surrounding technology.

4.2 Gender analysis in computing: the data

4.2.1 European data

She Figures is a research project promoted by the European Commission and coordinated by its Directorate-General for Research and Innovation in cooperation with EU member states and the countries associated to Horizon 2020[17]. The research investigates the progresses made towards gender equality in European research and innovation fields by providing different levels of data on the representation of women and men amongst PhD graduates, researchers and academic decision-makers. The wealth of data contained in the document sheds light on differences in the experiences of women and men working in research institutions, with reference to relative pay, working conditions and success in obtaining research funds. Recently, the report has also included data related to the situation of women and men in scientific publication and inventorships, as well as the inclusion of the gender dimension in scientific articles.

The latest edition of the report has been released in 2016, so it allows us to portray a very up to date picture of the situation of gender equality in

[17] It is possible to download the report by accessing the e-library of the European Commission:
https://ec.europa.eu/research/swafs/index.cfm?pg=library&lib=gender_equality

technoscientific realms (She Figures, 2015). As a matter of fact, an entire chapter of the report (chapter 3) is dedicated to the participation of men and women in science and technology occupations[18]. Among the main findings, we learn that, while science and technology remains gender-biased realms, women keeps advancing in the field, having grown by an average of 11.1 % per year between 2008 and 2011 (She Figures, 2015, p. 42). The under-representation of women within the fields of science, mathematics and engineering in postgraduate education above master's level persists although, at the level of the EU-28, men and women appear to be equally employed in science and technology occupations. Nevertheless, comparisons among individual countries show different patterns of growth; for example, in countries such as Lithuania (65.5 % of women compared to 46.0 % of men), Latvia (55.0 % of women compared to 45.0 % of men) and Bulgaria (55.0 % of women compared to 45.2 % of men), the presence of women in technoscience is higher than that of men, whereas other countries such as Malta (66.7 % of men compared to 54.5 % of women) and Italy (65.1 % of men compared to 54.6 % of women) register the opposite trend.

However, despite improvements since 2004, women remain strongly under-represented in several narrow fields of science and technology. A look at the sub-fields that make up the broad territory of science and technology disciplines provides a more nuanced understanding of gender patterns. According to the data,

[18] According to the report, "prior to 2011, scientists and engineers were those who worked in: 'physical, mathematical and engineering occupations' and 'life science and health occupations'. With the new ISCO-08 classification (in use from 2011), S&E are those who work as: 'science and engineering professionals' (ISCO-08, Code 21), 'health professionals' (ISCO-08, Code 22) and 'information and communications technology professionals' (ISCO-08, Code 25)". (She Figures, 2015, p. 19).

the worst situation in terms of gender balance seems to affect the field of computing[19]. As researchers report:

> Despite these improvements, women continue to be under-represented in most sub-fields of science and engineering. This is a particularly acute issue within computing. As mentioned above, women accounted for only 21% of PhD graduates in this subject in 2012. In that year, women made up less than a quarter of PhD graduates in computing in 15 countries (BE, CZ, DE, EE, ES, FR, IT, LV, HU, AT, SI, SK, UK, CH, TR); in six of these (BE, CZ, EE, HU, SK, CH), women accounted for less than 15 % of computing graduates. The only country coming close to gender balance in this field was Ireland, where women made up 45% of PhD graduates in 2012. In general, progress in the field of computing appears to have been slow, given the low starting point from which it began. In the EU, the field of computing registered an increase in women's representation of only 5 percentage points between 2004 and 2012 (at PhD level in the EU-28), and five countries saw the proportion of women graduates fall (EE, IT, LT, HU, CH). (She Figures, 2015, p. 32)

The underrepresentation of women in the field of computing is a critical issue that affects all European countries aside from Ireland. The gender imbalance also emerges from the 2012 edition of the report as the following table indicates:

[19] The narrow field of computing includes several subjects related to computer science such as system design, computer programming, data processing, networks, operating systems and software development. Hardware development is classified within engineering fields.

Annex 2.3: Number of ISCED 6 graduates by narrow field of study and sex in natural science and engineering (EF4 & EF5 fields), 2010

	Science, Mathematics & Computing (EF4)								Engineering, Manufacturing & Construction (EF5)					
	Life science		Physical science		Mathematics & statistics		Computing		Engineering & engineering trades		Manufacturing & processing		Architecture & building	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
EU-27	5 511	4 161	3 942	7 517	861	1 854	645	2 823	2 506	8 324	428	599	670	1 325
EU-25	5 413	4 088	3 923	7 499	739	1 680	641	2 820	2 172	7 540	424	593	657	1 304
BE	72	71	73	151	24	31	6	48	129	307	8	20	15	22
BG	25	13	19	18	5	4	4	3	34	78	4	6	4	4
CZ	152	96	90	187	16	45	11	64	36	271	24	11	33	74
DK	0	0	0	0	91	170	0	0	98	235	0	0	0	0
DE	1 629	1 230	1 041	2 391	134	391	116	722	224	1 659	56	121	108	346
EE	16	11	11	16	0	2	2	10	5	13	0	0	3	4
IE	95	71	58	82	6	11	14	57	24	84	1	0	3	14
EL	38	16	67	106	11	40	28	105	70	215	:	:	27	49
ES	728	485	269	412	86	120	68	237	333	686	54	34	59	130
FR	1 070	867	909	1 785	87	270	144	498	275	868	45	47	56	88
IT	691	310	539	703	127	161	33	116	116	385	181	480	382	415
CY	1	0	2	1	1	1	1	5	0	2	0	0	0	1
LV	2	2	5	7	0	0	2	2	2	12	6	2	2	4
LT	20	8	21	17	6	3	6	5	21	38	:	:	10	12
LU	0	4	1	0	0	2	2	7	1	5	0	0	0	0
HU	69	55	72	107	11	31	7	44	17	41	9	16	9	8
MT	1	2	0	1	0	0	0	0	0	1	0	0	0	0
NL	0	0	188	311	0	0	0	0	113	370	0	0	0	0
AT	118	66	55	163	25	36	13	116	93	265	3	7	28	65
PT	131	69	76	72	38	18	14	31	106	134	22	7	73	57
RO	73	60	:	:	117	170	:	:	300	706	:	:	9	17
SI	50	30	25	29	1	4	2	14	8	61	5	15	1	3
SK	136	76	56	88	29	23	8	53	103	289	36	45	36	55
FI	78	39	40	80	10	29	14	36	82	240	10	7	7	10
SE	123	106	140	205	28	71	32	74	192	498	40	59	26	28
UK	884	784	912	1 599	135	382	151	692	353	1 616	105	202	161	334
HR	59	27	39	32	5	8	3	16	23	66	11	9	9	16
MK	3	1	2	1	0	0	2	3	1	2	0	0	2	6
TR	103	90	218	232	71	64	23	51	66	230	118	91	89	99
IS	2	3	4	7	0	1	1	1	1	1	1	2	0	1
NO	0	0	0	0	0	0	141	291	0	0	0	0	2	4
CH	202	198	140	331	8	43	10	93	77	285	6	4	16	50
US	4 066	3 600	1 659	3 404	476	1 116	349	1 250	1 375	4 765	222	682	284	653

Exceptions to the reference year: FR: 2009; IT: 2006; NL: 2004.

Data unavailable: EU-15, IL, JP.

Others: ':' not available.

Most tertiary students study abroad and are not included: CY.

Most PhD (ISCED 6) graduates study abroad and are not included: IS.

Source: Eurostat - Education Statistics (online data code: educ_grad5).

Table 1. Number of European male and female graduates in STEM. (Source: She Figures, 2012)

The table 1 shows the evolution of the proportion of female doctoral graduates in scientific and technical disciplines from 2002 to 2010. If we look at the general European data (EU-27), we see that the field of computing has registered the slowest growth of female PhD graduates (17 in 2002 and 19 in 2010). In absolute terms, indeed, the highest share of female PhD graduates was observed in life science (57% in 2010) whereas the lowest rate was registered in computing (19% in 2010) and engineering and engineering trades (23 % in 2010). However, computing and engineering are the fields in which the number of female PhD graduates has increased the most. As for gender proportion, both the 2012 and 2015 reports point out that the fields of science, mathematics and computing and especially of engineering, manufacturing and construction are characterized by a strong gender imbalance. Thus, if education, health and welfare and the humanities remain female-dominated fields whereas science, mathematics and computing and especially engineering, manufacturing and construction continue to host mainly male PhDs.

According to several research findings (Giancola & Fornari, 2009; Triventi, 2015), these numbers point to the diversification, hybridization and multiplication of scientific disciplines which have favored more female access and the feminization of biology-related educational and professional paths. On the other hand, computing and certain engineering areas remain highly male-dominated, with a very slow increase in women's representation. Another interesting remark to bear in mind is the low propensity to integrate a gender dimension in research content on the part of subjects such as engineering, technology and natural sciences in the EU-28. However, this

seems to be a changing situation as engineering and technology registered one of the lowest proportions of publications with a gender dimension (0.1% in 2010–2013), but the highest growth rate between 2002 and 2013 (14%).

4.2.2 Italian data

Italian data seem to reflect the general European trend as far as the fields of Computer Science, Computing, Electronics and Automations are concerned. The following table displays the number of female and male MA and PhD graduates in 2013 and 2014.

	Master's or equivalent	Doctoral or equivalent
Total	965	135
Males	774	92
Females	191	43

Table 2. Number of graduates in Computer Science, Computing, Electronics and Automation. Years: 2013-2014. Country: Italy. Source: Eurostat (online data code: educ_uoe_grad02)

As for MA graduates, the total number is 965, whose 774 are male whereas 191 are female. The number of men, therefore, is nearly four times that of women. In the case of PhDs, the disparity decreases as we can count 92 male and 43 female graduates out of a total number of 135 graduates. Anyway the percentage of men is significantly higher than that of women.

As we see in the next paragraph the acknowledgement of a clear imbalance between men and women in terms of numbers is the first issue that has come up during interviews with female professionals and students in computer science and

computer engineering. However, while the analysis of data in terms of gender distribution among different fields as well as the compound growth rate in the same field is crucial in order to detect interesting variations, it is important to examine the internal articulation of each fields in order to understand the nature of statistical fluctuations as it is illustrated in the next section.

4.2.3 Beyond data

The gender gap and absence of women in computing and computer science has been well documented by She Figures reports and other studies (Hill, Corbett, & Rose, 2010; Hayes, 2010). Several dynamics such as “glass ceiling”, “leaky pipeline”, “sticky floor” and “glass cliff” have been identified to describe female segregation and exclusion from science and technology professional paths. However, looking just at data and the positive or negative trends they suggest can inhibit a more nuance understanding of such phenomena as Henry Etzkowitz and Marina Ranga have pointed out, for “the seeming indicator of a solution can also be an indicator of a continuing problem” (2011, p. 143).

The authors identify a dynamic they called “field status paradox”, which refers to the low status of a field when women are in large numbers and, conversely, the increasing high-status when the number of women declines and pay increases. According to this interpretation, therefore, even when science and technology fields are highly populated by women, that does not necessarily translated into high-status roles. Among the several examples that Ranga and Etzkowitz mention to describe this phenomenon, there is precisely the case of women in the early digital computing era.

During WWII women in fact were employed in great number as “coders”, a low-status skilled work compared to the higher status of male scientists and engineers who designed computing machines. With the increasing professionalization — thus increasing high-status — of programming, an increasing number of men enters the profession, soon outnumbering the amount of women programmers. The field-status paradox seems to be an accurate analytic device to read the changing gender balance in professional paths, inviting researchers to go beyond the mere acknowledgment of numbers. Additionally, this conceptual construct allows to shed a fresh light on the long-standing gendered character of science and technology, and computing more specifically, by pointing to the pervasiveness of gender scripts which are to be found in organizational culture, selection and promotion criteria, social stereotypes and ordinary sociomaterial practices. Against this background, suggestions that go in the direction to merely include more women in computing do not have the effect to improve gender awareness in IT culture. Faulkner and Lie (2007) have effectively disentangled this issue claiming that “inclusion is not just a mirror image of exclusion” (p. 157) and that, therefore, achieving inclusion is a goal that require different and tailored strategies rather than a “one size fits all” vision.

Another compelling issue that is somewhat concealed in statistics that certify the shortage of women in computer science and related professions is the lack of information regarding women’s success as computer science students and professionals (Balka, 2000). Studies aimed at exploring women gender awareness and practices of networking in computing and computer science are even lesser insofar as the field is still relatively young compared to other scientific disciplines such as

mathematics, physics, engineering, thus most of the research in this area tends to address the issue under statistical terms or by emphasizing general mechanisms of segregation and exclusion of women from computing fields.

By drawing on notable studies that explore gender issues in computing and computer science going beyond the acknowledgment of data (Margolis & Fisher, 2002; Misa, 2010; Abbate, 2012), here I seek to investigate not the reasons why women are left out of IT professions, but rather the reasons, motivations, beliefs, values and practices of female students and professionals that inhabit computing and computer science. Moreover, I have taken up actions and discourses of those women engaged in national and international networks that are committed to speaking out about gender troubles in IT world and promoting gender awareness and women presence into computing educational and professional paths.

4.3 Networking and gender awareness in computing: case studies

4.3.1 Networking practices

The issues of gender gap and gender trouble in computing are no longer neglected by academic research and institutional agenda. A major evidence of such awareness is the introduction of gender as a cross-cutting issue within Horizon 2020, the biggest EU research and innovation programme. Among its main leading principles, Horizon 2020 aims at achieving gender equalities by pursuing three specific objectives: fostering

gender balance in research teams, ensuring gender balance in decision-making, integrating the gender dimension in research and innovation content.

Alongside major institutional initiatives, private companies and spontaneous groups of women are increasingly committed to promoting more women and more gender awareness into computing education and careers. These are initiatives of female networking and mentorship (Cozza, 2011) which aim to increase the number of women participating in computer science by advancing a number of different initiatives, from seminars to workshop, from hackathons to local educational programs. Over the course of recent years, indeed, the number of groups and campaigns in this regard have flourished: the Anita Borg Institute, Girls Who Code, Black Girls Code, GNOME Outreachy, Ada Lovelace Day are just some of the many initiatives that help young women (white and of color) to develop computing skills, grow their careers, raise their profile in technology and engineering, and encourage trans women, trans men, and queer people to get involved in free and open source communities. It is important to clarify that all these cases alongside those ones I have specifically examined for my research are located in Western countries despite the fact that there is no lack of similar initiatives in developing countries.

My research has examined six cases of networks and initiatives which are committed to enhance the presence of women in computer science and engineering. More specifically, I have probed the experiences of those female professionals and students who are involved in such campaigns so as to explore their motivations, concerns, and views on gender issues in computing. The interviews I have carried out have been structured according to three macro-themes: educational paths, gender

issues in computing, viewpoints on and experience in informatics. In doing so, I have tried to challenge those popular rhetorics that describe computing as an unwelcoming place for women. The female students and professional I got the chance to meet find computing and engineering as an empowering, interesting and funny world while, at the same time, they do not disregard the gender issues in the field.

Most of the women interviewed are Italian and range between 23 and 71 years old. For reasons of confidentiality I have changed their names while those of the networks to which they belong are real.

4.3.2 Girls Geek Dinner

The first organization I came across is Girls Geek Dinner (GGD)[20]. Girls Geek Dinner in an international informal network founded in London, in 2005, by Sarah Lamb. According to the information available on the official webpage, GGD's mission consists in breaking down old fashioned social stereotypes, fostering access to technology for anyone, encouraging and nurturing those interested in technology, working with local schools, colleges and universities to encourage more women into the technology industry, supporting women currently in the industry, including men, women and children in the initiatives. As the name suggests, the central activity of GGD project is organizing dinners open to women interested in technology. Men can only attend as invited guests of women, so as to be sure that women will never be outnumbered by men at events.

[20] http://girlgeekdinners.com/

Sarah Lamb, an English independent consultant and computer science graduate, set out the idea of women-only geek dinners after having attended some events in tech world and having realized "how isolated women in the industry were". Additionally, she claims that some men working in technical realms do not "really know how to react to a technical female". Accordingly, she organized the first girl geek dinner in London, deciding to include men without making female attendees a minority. After the first dinner held in 2005, the initiative became a network spread across 24 countries, within 53 cities, involving 27.912 people (data up to January 2011). Dinners are usually organized around specific topics related to information technology (social media, cybersecurity, 3D printing etc.), on which female professionals are invited as main speakers. Similar events, therefore, aim at promoting networking among women (and men) who hold different positions in IT world.

GGD has its Italian chapters in several cities across the country: Rome, Milan, Bologna, Sicilia, Northeast. I got in touch with a member of GGD Rome shortly after the beginning of my PhD in 2013, during the events organized as part of Codemotion, one of the biggest tech conferences in Europe focusing on software development and coding[21]. After having participated to this first meeting, I also met some members from Milan's chapter.

4.3.3 Project NERD? – Sapienza University

Many initiatives aimed at promoting young women in technoscientific fields involve educational institutions such as schools and universities. Project NERD? is promoted by

[21] http://www.codemotionworld.com/about/

the Computer Science Department of Sapienza University in collaboration with IBM[22] and organize laboratories and seminars to introduce high school female students to computer science and those who work in this field. While NERD? recalls the popular image of the white, male guy lacking social skills and interested in technical activities, games and fantasy literature (see Gandolfi, 2014), the acronym stands for "non è roba per donne?" ("It's not stuff for women?"), thus calling into question precise social stereotypes that regard computer science and technology more in general as masculine domains (Van Oost, 2000).

According to the official statement, the NERD? Project aims to combat the prejudice by which computer science is a matter for nerds, geeks and videogame lovers lacking skills in social communication: "NERD? Aims to show how computer science is a creative, interdisciplinary and social subject, based on problem solving, activities at which women excel" (from NERD? Project's webpage). In collaboration with IBM, the initiative sets up courses and contests for high school female students who learn how to develop apps for smartphones by using AppInventor, which is an open-source web application for novices.

Beside coding courses, NERD? project organizes a set of mentorship activities with female professionals along with present biographies about successful women in computing world such as Susan Kare, Sheryl Sandberg, Marissa Mayes, Grace Hopper, Ada Lovelace and others.

[22] http://www.progettonerd.it/?q=progetto-nerd-

4.3.4 Microsoft Pink Cloud

Alongside educational institutions, several companies operating in IT are increasingly committed to promoting more women in computing fields. A notable international program is, for example, "Google Diversity" which aims to uncover and address bias against LGBT people, women, and people of diverse race, religion, and provenances[23]. Another growing initiative is the Pink Cloud founded by Microsoft Italy[24]. According to the official statement, "Pink Cloud was inspired by the awareness that undertaking technical and scientific studies and acquiring digital skills helps young women enter the workforce and enables an equitable gender presence in the industry, economy, politics and social life". The project started in 2013 in Florence, then it has been taken place in Rome in 2014 and in Milan in 2015. The latest edition offered to 1500 young Italian and foreign women, aged 17 to 24, three days of courses, seminars, workshops, networking moments and meetings with companies in order to promote technical and scientific training and the opportunities offered by the digital world.

The project is organized and managed by Microsoft and its business partners (ASUS, Aviva and Accenture), in partnership with important institutional actors such as UN WOMEN, the United Nations body for Gender Equality and Female Empowerment, UNRIC and ITU, and is supported by the Department for Equal Opportunities, the Agency for Digital Italy, and the Ministry of Education, Universities and Research. I participated to the second and third editions of the Pink Cloud, doing participant

[23] https://www.google.com/diversity/at-google.html
[24] https://www.nuvolarosa.eu/en/

observation, interviewing organizers and speakers as well as talking to some female students involved in the activities.

4.3.5 Ubuntu Women

During my research on initiatives and projects aimed at bridging gender gap in computing, I have gotten the opportunity to trace the diversity of voices and political visions that populate the broad field of informatics. In this regard, I participated to initiatives and met people involved in open source communities such as Debian and Ubuntu. Ubuntu is an operating system and distribution based on free software which can count on the support of the Ubuntu Women Project, an international community committed to fostering women's involvement through mentoring and inspiration. The project focuses on improving the presence and visibility of women within all areas of Ubuntu.

The community works mainly through online channels such as mailing lists, blog, online surveys, forums, chat. The participation of women concerns all the activities that drive the life of the community such as helping other users, translating programs or documents to local language, testing the software and reporting bugs, creating artwork or writing documentation, fixing software bugs, creating new software or keeping others' software up to date. The range of activities the community covers, therefore, entails both technical and non-technical training.

The Italian branch of Ubuntu Women Project sets out precisely with the idea of constituting a meeting point for Italian users, regardless of their technical experience and background. The project takes shape from the international forum and mailing list

and seeks to fill potential linguistic and cultural gaps that hinder a full participation of women to international platforms. As it is claimed in the webpage of the initiative, Ubuntu Women-it "is a project that aims to discover and promote women within Open Sourcem and Ubuntu in particular, by helping newcomers or by offering a space for discussion to those who already have a certain mastery of the operating system. The project aims to build a space mainly for women, in which they freely discuss issues that might involve them more"[25].

4.3.6 Girls in Tech

Similarly to Girls Geek Dinner, Girls in Tech (GIT) is an international non-profit network focused on the engagement, education and empowerment of girls and women who are passionate about technology[26]. The organization is committed to promoting and accelerating the career of women who would enter the high-tech industry and build successful startups. The initiative has been founded in San Francisco by entrepreneur Adriana Gascoigne in 2007. Up to date, the project entails 37 chapters across the world and involves 17.000 members.

The project offers a diverse range of initiatives and tools such as workshops, lectures, networking, round tables, conferences, social engagement, events dedicated to recruitment, entrepreneurship school in order to integrate and further reinforce women's careers and aspirations in tech world.

[25] http://wiki.ubuntu-it.org/GruppoPromozione/UbuntuWomen
[26] https://girlsintech.org/#about

The Italian chapter is based in Milan and covers a number of activities such as spreading helpful information through the blog and organizing events in collaboration with business partners such as big companies like Google and Telecom Italia or innovative startups. Participation to events can be free or paid. Italian team is made up of 7 women with training in economics, marketing, communication, engineering, and law.

4.3.7 Wister - Women for Intelligent and Smart TERritories

Women's initiatives in IT also concern the realm of public administration. This is the case of Wister - Women for Intelligent and Smart TERritories, which is a female network officially presented in 2013 during the Italian forum of public administration[27]. The network is part of the General Conference of Innovation, which is made up of several associations, social movements, companies and citizen committed to innovating the country by reducing digital divide and promoting the open government.

According to the official claim, Wister aims to inform, advance, and report news and events related to gender issues, with particular regard to new technologies. This is the most heterogeneous network I came across insofar as it is composed of women with very different training and backgrounds: engineering and computer science, economics and social sciences. Its scope of activities and interventions is rather broad, indeed. From Wister's webpage we learn that the organization aims to ""promote innovation policies sensitive to the differences, starting from gender ones. Recognizing

[27] http://www.wister.it/siamo-wister/

and integrating the needs, interests and skills of women in research, in projects and debates on innovation, promoting initiatives to bridge the gender digital divide, to support women startups, to increase the presence of women in study and career paths in ICT, to improve the synergy between social innovation and the strictly technological innovation".

Women involved in Wister work in public administration, private sector, universities and elaborate information materials such as ebooks and positions papers, and organize public events such as conferences, workshops and lectures.

Figure 2. Logos of networks and campaigns involved in the study

4.4 Discourses and practices around the recruitment of women into computing

4.4.1 "We are very few": numbers matter

Although computing and computer science have been greatly populated by women as seen with respect to "ENIAC girls", nowadays they represent a typical example of a technoscience that has excluded women (Lagesen, 2007). Indeed, since the early 1980s, various narratives have focused on the exclusion of women, developing popular narratives that describe computer fields as technical worlds "where women and femininity appear as matter out of place" (Sørensen, Faulkner, & Rommes, 2011, p. 45). The acknowledgement of the low number of female students in computer science and engineering is also one of the first issues that has come up during interviews from women of different ages. Here is the reflection of Maria, who started studying electronic engineering in 1984:

> When I started engineering at university, we were 10 girls out of 250 students. My group of female students attended throughout the 5 years, so everyday was like this. Then I accompanied my brother to the law department, I took a look around in Crociera Room at University of Milan and I said "oh, this is a different world". I studied electronic engineering, actually it was computer science but back then it was all electronic. We were counted according to our surname and the percentage of women was of 4%. But today it has not changed. (Maria, engineer and IT consultant, member of GGD Milan)

As Maria points out, the number of female students when she studied electronic engineering at Politecnico in Milan was rather low. Such disparity appeared more evident when she got the opportunity to visit the law department where her brother

studied, an entire “different world” looking at the differences between the number of men and women. According to Maria, statistics about the presence of men and women in computer science programs have not changed over the years, a concern that seem to be confirmed by Lara and Tina, currently MA students in computer science and computer engineering at “Statale” University and Politecnico in Milan respectively:

> The thing that has struck me the most is that, when I moved to Statale from Politecnico, I was expecting to find out more girls, but rather I have founded fewer. Even in the course of online game design there is just another girl, we are just two. Instead, in my class at Politecnico, we started in ten, then several girls dropped out, others lagged behind, but yet other older ones moved to our class insofar as they lagged behind. Anyway, initially we were around 10 out of 150 students, so I think that the percentage of women in engineering is around 10%. At Statale, instead, I have seen fewer women and I did not expect that to be honest. In the course of online game design we are 2 girls out of 30 students, and in the course of software development in complex work groups I think we are 3 girls out of 30 students. (Lara, MA student in Computer Science).

Here Lara, who is a MA student in Computer Science at University of Milan and a videogame lover, recalls the shift from Politecnico — where she studies computer engineering for her bachelor programme — to “Statale” — where she currently studies computer science. Lara does not hide her perplexity in finding fewer girls than she expected when she moved from an engineering course to the programme in computer science. However, at a closer look, the percentage of women seems to be roughly the same, revolving around 10% both at Politecnico and Statale. The reasons behind Lara’s bewilderment, indeed, might lie in her expectation to find more women than those at Politecnico, and in the general lower number of students in MA programme (around

30) compared to the 150 freshmen she encountered at the beginning of her bachelor programme.

The overall low number of women in engineering at Politecnico is indeed confirmed by Tina, who is currently in her first year of MA course in computer science and engineering:

> I think in the first year we were 150/160 in our batch. We are divided into three batches, so we are more or less 450 people. In my batch, we were 8 women and few of them have survived, so yes, 8 out of 150. I have graduated in time and the girls who also kept up with classes… we would have been 4. The day of my graduation I was the only woman to graduate in the room. Now it is a bit more complicated to say, because now it's the opposite, all courses are to be chosen, not just for us from computer engineering, but there are also some boundary subjects — such as mathematical engineering, biomedical engineering — which are hybrids, so for example many biomedical students do biotechnology, therefore there are more women, but from computer engineering we are still very few. (Tina, MA student in Computer Engineering)

Here Tina tells something interesting. Besides confirming a percentage of roughly 10% of women in the bachelor programme she attended, she also hints at how educational paths tend to blur their boundaries in the MA cycle due to the presence of what she calls "boundary subjects" such as mathematical engineering and biomedical engineering, which, according to her experience, would present a higher amount of female students compared to the still few women in computer engineering. A similar acknowledgement unveils two interesting insights related to each other: firstly, engineering — in this case — is not a homogeneous field in terms of gender distribution insofar as several branches (biomedical, mathematical) present more women than others (computing, manufacture), and, secondly, the fields more

attractive to women seem to be interdisciplinary areas that combine different technoscientific knowledge and training.

The scant presence of women in computing is not just an issue affecting educational paths insofar as it becomes more evident in volunteering activities such as those required by open source communities. Here is the reflection of Eva, who recalls the time she has joined the community of Ubuntu Women:

> When I arrived, there were really few women. There was no woman in the board, no women among the moderators of the forum, there were very few women. It was just a fact of presence, there was no presence, there were very few. (Eva, communication manager, co-founder of Ubuntu Women Italy)

Here Eva remarks the first issue that emerges when it comes to the discussion about gender issues in science and technology, namely the actual absence of women. This is not a matter of visibility, namely to make visible the contribution or the presence of women that has been concealed as Rossiter puts it (1993), so it does not concern invisibility of women and other marginal groups, but it has to do with the very lack of them. While recognizing the low presence of women in computer science can appear an obvious issue, this is anything but trivial insofar as no further inquiries — such as the supposed symbolic and material construction of computing as a masculine realm, the emergence of critical approaches to information and computer science — would have been posed without the acknowledgement of the absence of women. As several studies located in different geographical contexts have pointed out (Lagesen, 2007; Margolis & Fisher, 2002), the analysis of numbers is crucial in order to even think about gender issues in computing and, then, to explore further readings and

approaches to the problem. Additionally, the recognition of a neat disparity in the number of men and women is important inasmuch as it is the foremost ground that sustains the emergence of women's networks I have examined as well as the first concern that motivates female professionals in computing to join and create these networks in order to promote more women in the field.

4.4.2 Programming: women can do it!

"Dumb things: women can't program, women don't like to program, women aren't good programmers". With such empowering claim, Phoebe, an American engineer from San Francisco, addresses a large audience of young female students during a Rails Girls event hosted by Girls in Tech Italy in Milan. Phoebe is a young and enthusiast engineer working at GitHub, a popular site that programmers use to store their software projects, share them, and work on them collaboratively in teams. Phoebe is also a "Rubyist", that is a user and advocate of Ruby[28], a general-purpose programming language also used to write Ruby on Rails[29], an open source web application framework that provides default structure for databases, web services, and web pages. I met Phoebe during an event organized by Rails Girls[30], which is an organization founded by Finnish computer programmers Linda Liukas and Karri Saarinen, aimed at making technology and coding more approachable for girls and women. The network sets up workshops to help women learn basic programming

[28] https://en.wikipedia.org/wiki/Ruby_%28programming_language%29
[29] https://en.wikipedia.org/wiki/Ruby_on_Rails
[30] http://railsgirls.com/

through Ruby on Rails. Since the first event, held in Helsinki in November 2010, Rails Girls has puts on workshops in 160 cities across the world[31].

The atmosphere throughout the workshop I attended in Milan was very friendly and relaxing. It seemed to me that the overall effort by the organizers, coaches and speakers was that of rendering an image of computing and programming as much exciting and funny as possible, as also posters hanging on the walls of the room showed:

Figure 3. Poster Rails Girls

During the workshop, which was hosted by the local chapter of Girls in Tech, Phoebe volunteered as "coach" and keynote speaker to share her experience with the high school and university girls who subscribed to the event.

[31] http://sdtimes.com/for-the-love-of-gore-the-linda-liukas-story/

In recounting her story, Phoebe told that she studied philosophy in Texas, and, after graduation, she wondered what was “the thing that is changing the world”. Then, she moved to San Francisco and decided to become a programmer, joining GitHub, which is one of the biggest and most popular communities of programmers where — she claims — 1 out of 5 is a woman.

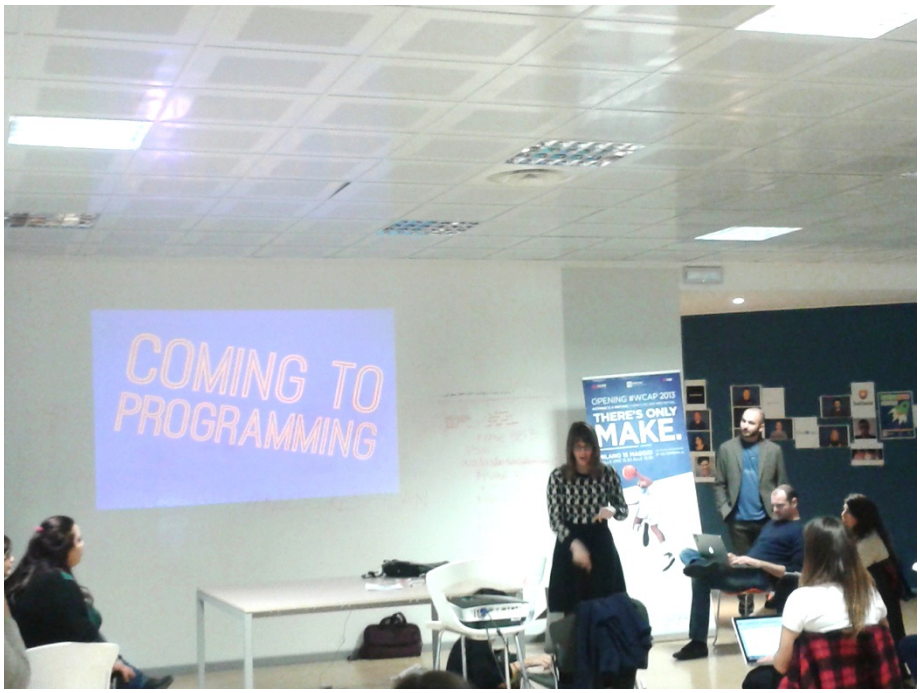

Figure 4. Talk during the Rails Girls’ workshop

After her speech, I had an interesting conversation with Phoebe, who told me more about her experience in the computing world. I founded her an enthusiastic and, at the same time, well aware person. She told me that, after having been graduated in philosophy, she needed to deal with something more concrete and, at the same time, helpful for people. She wanted to become “the President” and change the world, so she decided to become a programmer. She remarked the fact that there are few

women in IT industry in the USA, and that they are not well paid. In videogame industry — she added — the situation is even worse as there are cases of sexual harassment in the workplace. Nevertheless, she stressed the need to educate girls to computer science by teaching them mathematics and all the knowledge useful to make them more confortable with the computer.

Phoebe's views on girls' technical education are somewhat revised by Sara, another speaker and coach who took part to Rails Girls in Milan. Like Phoebe, Sara is in her late twenties. She was born in Rome, but she lives in Vienna where she studied visual arts and works as software developer for two companies. Sara introduced herself by saying: "I have always liked design and typography, math on the contrary…". Sara, indeed, confessed to the audience that she has always had problems with math and logic, but that Ruby on Rails helped her to overcome such adversities and not to be scared of making errors in order to figure out what happens in her computer. After having been introduced to Ruby, Sara becomes one of the organizers of the Wordpress and Python Ladies (PyLadies[32]) meetups in Vienna. Like Phoebe, Sara volunteers for promoting more women in computing and, above all, she encouraged girls to approach programming and not to be afraid to try: "It may be that at the end of the day you will not want to have anything to do with programming. This is not a problem. The problem is not wanting to take the first step because <<it's just for boys>>".

[32] http://www.pyladies.com/

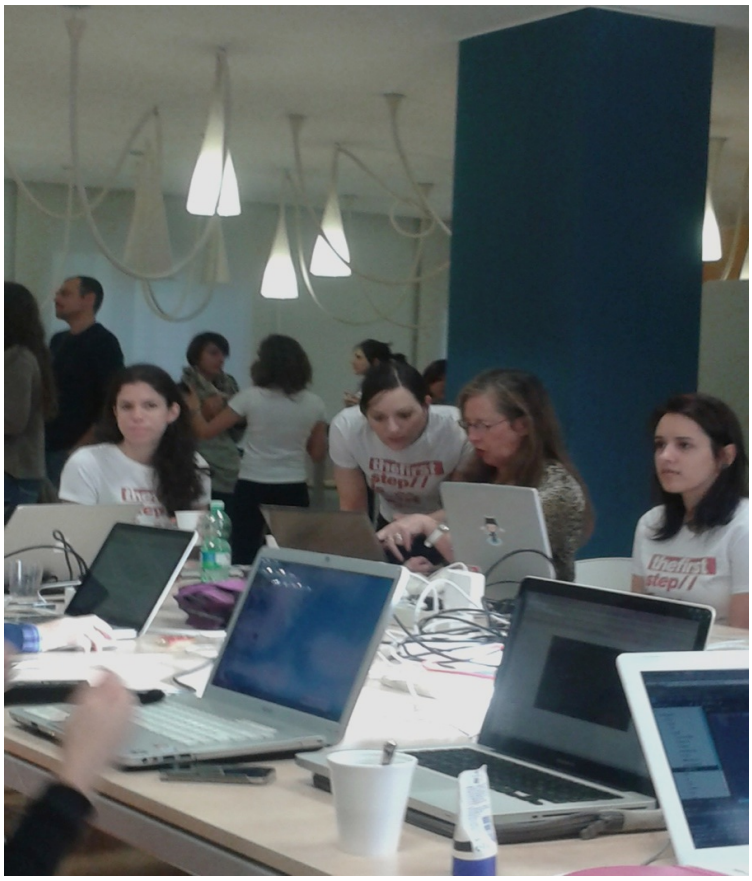

Figure 5. Rails Girls' workshop

Indeed, as the claim printed on the t-shirts that girls were given states: "the first step is to start".

4.4.3 "The pink aspect": problematizing women access to computing

As illustrated in the previous section, the fundamental goal driving campaigns toward the promotion of women in computing is reducing the distance between men and women. While activists and promoters of these initiatives acknowledge the scant presence of women in IT, they volunteer by putting forth, in the first place, their

positive experience in studying and working in computing as well as their commitment to addressing gender troubles, sexism, and discriminations.

Following these considerations, I have been in fact driven by the interest in exploring what keeps women *in*, rather than *out*, computer science by investigating motivations and reasons behind the choice to study and work in computer paths. This line of research has allowed me to discover how relations between gender and technology are complex and dynamic, and in many respects they contradict binary understandings that see computer science as a masculine domain that makes women feel unwelcome. According to this view, in order to *fit in* the field women should give up their femininity or being concerned of appearing "too feminine" (Dunbar-Hester & Coleman, 2012; Corneliussen, 2014). In contrast to this widely held interpretation that regards technology as a terrain inherently masculine, several studies in the field of STS and feminist STS have unfolded an articulate range of connections between women and technology (Pinch & Trocco, 2002; Corneliussen, 2005; Abbate, 2012; SSL Nagbot, 2016) and problematized the stability of gender identity (Landström, 2007) as well as the supposed heterodoxy of computer design which may instead help contesting fixed notions of gender or assignment of roles (Light, 2011). For example, in their study about the invention of the Moog synthesizer, Trevor Pinch and Frank Trocco (2002) recognize the tricky relation between gender and the synthesizer by claiming that, while electronic music technologies have been traditionally associated to masculine identities, several women have developed intense personal connections with their synthesizers to the point that, through such interaction, they were able to contest the gender identity society assigned to them. In a similar vein, a recent special issue of the

Journal of Peer Production on “Feminism and (un)hacking” grapples with the liberal ideals of freedom and meritocracy by putting forth new matters of concern informed by relations of care, repair, intimacy and hope (SSL Nagbot, 2016).

In line with these considerations, interviews I have conducted with female students and professionals in computing tend to dispute two commonplaces at the heart of recruitment campaigns and discourses surrounding the field: women are particularly good with people and at developing communication skills (Lagesen, 2007; Lagesen & Sørensen, 2009; Corneliussen, 2014), and, by the same token, they do not like particularly technical and scientific subjects which are often depicted as adverse masculine mastery. On the contrary, feelings of love, passion and attachment lie behind women’s engagement with computer science and engineering along with rather close relationships with their male colleagues. Here is Zelda, full professor of Computer Science at Sapienza University, describing her relationship with scientific subjects:

> I studied at the Liceo Scientifico and I loved mathematics, I still do love math. When I was 3 years old, I used to play cards with my grandfather, and I counted points. That is to say, I do not think I was particular for some reason… I think that everyone has certain talents. I can't carry a tune, for example, and I have my cousin who is an opera singer. There are innate talents. So, I think I was born with the same talent for mathematics. So for me the Liceo Scientifico was a natural landing place, but in elementary schools I had already decided that I would have studied something that had to do with math. And I have to say, studying was not hard for me, I feel a bit ashamed, but I actually liked studying and I especially liked math, I mean, I really had fun with math. I understand it is not like this for everyone. But, in fact, it is a gift, there are those who sing, who can paint, those who easily learn 20 different languages and I… (Zelda, full professor in Computer Science, interview)

Here Zelda describes a rather close attachment to math. In her view, her passion for mathematics is an innate talent, similar to a voice naturally in tune. According to Zelda, her inclination towards mathematics was nothing special, but just a natural ability to excel in that field. Her explanation, therefore, does not pertain to rational or utilitarian reasons, but it refers to an inborn gift that has driven her educational and professional choices. Furthermore, her thinly veiled sense of shame to reveal how much she liked studying, especially mathematics, seems to unveil precisely the struggle with a certain understanding that sees women as not enthusiastic and reticent (Turkle, 1988) about computers and scientific subjects, whereas boys naturally find computers pleasurable.

However, if the majority of the women I met attributes the choice to undertake a career in computer science to passion and interest in mathematics and technical tinkering, there are also slightly different experiences, as in the case of Viola, who recounts the time before applying to the computer engineering program as following:

> It's a dumb thing, but it went by exclusion. You know, at the beginning I wanted to study communication. I liked the idea of communication, I saw the computer and computer science as a means of communication, able to connect people in order to communicate. However, the educational offer did not convince me because I wondered "what can I do next?". I wanted something more technical, more... I do not know how to say, I liked studying, but it [communication] seemed to me little concrete actually, I liked writing but I also liked scientific subjects. Therefore, I eventually landed up on computer engineering because the aspect of communication related to information technology as a computer system, as a way to connect people stood, and it was engineering on the other hand, which had the scientific part I was interested in. (Viola, engineer, member of Ubuntu Women Italy, interview)

As this excerpt points out, Viola did not consider studying computer engineering as her first choice, but rather it appears to be a good link between her primary interest

(communication, writing, connecting with people) and the need to envision a clear path after university which, in her words, “something more technical and concrete” like a degree in engineering could offer. From Viola’s words computer systems and computer engineering as educational path emerge as a crossroads where different motivations converge. Additionally, Viola’s hesitation in undertaking a degree in Communication, and the consequent choice to study engineering, seems to reveal a relationship of subordination between different educational paths, which depicts engineering as a safer place in terms of employment opportunities than a degree in Communication. It follows that, according to Viola’s viewpoint, if computers and computer engineering present an “aspect of communication”, the opposite does not occur — that is communication does not hold a technical aspect.

The experiences so far narrated are somewhat at odds with those rhetorics that aim at recruiting women in IT by outlining a supposed model of femininity the sees women as more inclined to communication and social skills. Both Zelda and Viola were indeed spurred by other kinds of motivations that rely on a strong passion for mathematics on the one hand and safer opportunities of employment on the other. The so-called representation dilemma (SSL Nagbot, 2016), which aims precisely at recognizing the lack of diversity in technoscience along with attempting to push the boundaries of the heteronormative masculine culture of computing, is problematized by Neda, a computer scientist working in the public administration and promoting open source software:

> This issue [shortage of women in computing] is becoming popular to the point that, I dare to say, I have had enough of those initiatives that are also

> commercially exploited and that always associate the term 'pink' to technologies, which is a really absurd way of trying to fight a stereotype using another stereotype that is pink. As Girl Geek Life, we always say that in our presentations, it is deadly annoying for us because the fact of associating the pink to technologies gives a wrong message to girls, that is technology is the candy, the cute thing, it is a simplification of technology that women themselves actually do not hold. So, I don't understand the reason why they are told, like babies, "do get closer to technologies because they are cute, they are pink". Rather, we have to explain the real benefits of technology, because there are. Moreover, I am a computer scientist so I speak from personal experience, when women get access to informatics they don't do that superficially, I think the worst nerds that I know are women, so we are not necessarily fascinated by the pink aspect if we want to use the pink-term in this way. We are often fascinated by what is behind, the challenge that lies behind informatics, not at all because it is an easy job. They pass on an absolutely distorted message and it's a shame, it is really a shame. (Neda, computer scientist, open source advocate, interview)

Here Neda exemplifies some crucial issues that define the complexity of the gender-technology relation. Wendy Faulkner considers the technology question in feminism as lying in the simmetry by which "just as one cannot understand technology without reference to gender, so one cannot understand gender without reference to technology" (Faulkner, 2001, p. 90). Neda's words problematize precisely this assumption by challenging two opposite material-semiotic associations that regard technology as a traditional masculine domain on the one hand, and the opposite construction of female, thus pink-colored, technologies. As computer scientist, Neda's experience is similar to that of Zelda and Viola insofar far as noone of them has entered computing because of its supposed "soft" character.

Additionally, in challenging the dichotomous terms whereby technology is gendered, Neda also points to the heteronormative assumptions behind such dualistic understanding of informatics insofar as heteronormativity refers to the relationship

between gendered opposites – a male and a female. On the contrary, the claim "the worst nerds that I know are women" clearly shows how stereotyped gender identities constructed through a likewise stereotyped image of technology come undone in practice.

4.5 Gender troubles in computing

4.5.1 "Feeling for the solution": the question of difference as a contested zone

A general theme stressed during the interviews concerns the gender-technology relation, which has been addressed according to multiple viewpoints. A clear finding emerging from women responses was the gender difference in approaching and living computer science and technical artifacts. In point of fact, some of the female practitioners and students I have met point to different understanding and uses of technology among women. These differences concern two different dimensions: a specific cognitive and emotional disposition toward the subject and the practical use of technologies. Here is the experience of Zelda, full professor in computer science, recounting her disposition toward scientific subjects along with the one of her female students:

> I am a computer scientist. I have a degree in electronic engineering because, unfortunately, at that time there was not a computer engineering program in Rome. But as to my personal ability and passion, I come from a strong passion for mathematics. You know, I think that one of the characteristics, which I then have found in female students, is a great

> intuitive ability to feel, to see the solution, before being analytical. Because then there is the analytical part, the part of formalization and so on, but I often happen — just from my personal experience and the experience of some female students, unfortunately very few — to have a problem and to know, to feel in some way, not analytically and not precisely, that there was a certain way to its solution… (Zelda, full professor in Computer Science, interview)

Here Zelda delineates an early trope in the literature about the intersection of gender and science, namely the relationship between the person and the field. A seminal work in this regard is Evelyn Fox Keller's analysis on the life and research of Barbara McClintock (1983; 1987). According to Keller, an important aspect of the Nobel Prize laureate's work was the empathetic and individualistic style of her research in the field of cytogenetics, a particular disposition that, in Keller's view, cannot be detached from the issue of gender although McClintock always rejected female stereotypes as well as notions of "difference science" and "feminist/feminine science". Although Keller's reading of McClintock work has been criticized for the essentialist views on gender identities it would convey, Keller's herself clarifies that "feeling the organism" is in no way an argument in favor of a unique and distinctive woman's science. Indeed, the gender question in the life of the American cytogeneticist lies not just in her personal trajectory, but rather in her distinctive practice of science, which was marked by intuition, feeling, connectedness and relatedness for the plant of maze. It was precisely this persistence in seeing one kernel of corn that was different, and making it understandable, that distinguished McClintock approach in a time, the 1930s and 1940s, when genetics was becoming more quantitative (Hein, 1984).

According to Keller, this different approach to the practice of science was inextricably related to gender, with gender having a direct link to sex in this case. In other words, in Keller's view, McClinotck's scientific practice was marked as feminine by the masculine canon insofar as it was conveyed by a woman. However, many women have seen the Nobel Prize as the possibility of doing science that overcomes classical dichotomies. The highest recognition of the scientific work carried out by a woman, indeed, legitimizes the viability of difference within the world of science, not outside of it. It is precisely the difference marked by a sense of the problem, an intuition, which Zelda attributes specifically to women:

> Well, then one gets to work and find the formalization, the definition step by step. But there is a moment when there is intuition, which is a kind of intuitive intelligence. And in my opinion, but this is not just my opinion as over the years I have read many things written by sociologists or behavioral scientists who say that this is a typically feminine characteristic, typically. Then, of course, it is clear that, when they say this, they always say "on average", because maybe there is the particular man who is hyperintuitive and the woman who is not at all, but on average is a feminine characteristic. (Zelda, full professor in Computer Science, interview)

Here Zelda refers precisely to what Keller means as "feminine", that is "different". Being intuitive, in other words, is neither the case that all women are intuitive nor that men are not intuitive. It follows that 'men' and 'women', 'masculine and 'feminine', are not to be understood as polarized and homogeneous categories, but rather as different, even in terms of power and ways of approaching science. The heterogeneity of practices and beliefs regarding informatics, for example, is evident from the choice to shift from studying computer engineering to applying for a computer science program or from the choice of volunteering in open source communities rather than

supporting campaigns launched by private companies. In this respect, differences are anything but to be understood in terms of duality or universality.

The question of difference is invoked not just to describe cognitive and emotional attitudes towards scientific subjects, but it is also advanced to describe a practical approach to technologies performed differently by men and women. In relating her experience as editor for the online magazine *Girl Geek Life*[33], Neda points out the difference between men and women as far as technical reviews are concerned:

> The goal of the magazine is to give voice to women who speak of technology, we have over 40 female collaborators. Women experience technology differently from men and therefore they also tell about it differently. So, for example, we publish reviews on hi-tech objects, when you read a review made by a woman is definitely different from the review made by a man because the perspective is totally different. To crack a joke, I always say that women have a very practical approach, so if you give a smartphone to a woman, even before she picks it up she wonders what she can make with that, how that object can improve her daily life, how you can save time; if you give that to a man, he will pull it apart. This is the different approach that men and women usually have. (Neda, computer scientist, open source advocate, Wister member, interview)

While, in the previous section, we have seen Neda condemning the pink-colored image of computing some campaigns take up, here she claims a difference between men and women in using technology. In her opinion, women have a practical approach to technologies, meaning that they primarily look at the functional aspects of technical objects by asking: what can I do with this smartphone? How can this smartphone improve my life? On the other hand, men are oriented towards technology itself, its internal constitution, so they are more interested in how the object works rather than

[33] http://www.girlgeeklife.com/

for what purposes it can work. A similar view reinforces those assumptions by which women have *different* relationship with IT technologies that those of male geeks who are totally absorbed in technical gadgets (Misa, 2010; Corneliussen, 2005; 2014). However, as in the case of the "feeling for the solution" emphasized by Zelda, this difference in approaching technology does not reflect a "soft" — namely computer-phobic or less technical — approach undertaken by women as opposed to a male "hard" stance on computers. Rather, although the practical approach reminds to some extent to the rhetoric around feminine aspects such as communications skills and being good with people, here technology is openly genderized by Neda not to claim a disadvantage, but rather to emphasize what in her thinking is *another*, yet equally worthy, way to deal with technologies.

4.5.2 "The hard hat problem": women traveling in male worlds

As figures and numbers certify, computer educational paths and careers are domains quantitatively dominated by men. Nevertheless, there is no lack of women mentors and historical inspiring examples — from Ada Lovelace to Anita Borg, from Grace Hopper to Marissa Mayer — which are popularized to great extent by networks and campaigns aiming at bridging gender gap in computing. Such availability of references is an important aspect to be taken into account especially when it comes to address the age of women involved in the field.

This issue has emerged from the fieldwork when I met Frida during the first edition of the Pink Cloud I attended in 2014. Frida is full professor in Artificial Intelligence (AI) and Robotics, retired in 2015. She received her degree in mathematics

from Scuola Normale Superiore of Pisa in 1968, after which she started researching on Informatics at National Research Council (NRC) with a permanent contract. As she clarified during the interview, the choice of working at NRC, rather than at the university, was driven by the fact that at that time there were neither academic programs in informatics in Italy nor the recognition of computer science as an academic subject area. After spending 4 years at Stanford studying AI, she came back to Italy, and in 1982 she started working as full professor in the then newborn department of Electronic Engineering of an important university. As Frida told me, when she started there were just 3 computer scientists in the department. In 1990, she helped building the new department of Computer Engineering and, as she points out, "we invented the degree program from scratch". For this reason, Frida is considered a pioneer in the field of AI in Italy and, more in general, within the field of Computer Engineering.

To borrow a poignant expression from Silvia Gherardi, Frida can be regarded as a woman who has travelled in a male world throughout her career (Gherardi, 1996). Unlike female students and young professionals of the present day, who can count on several prominent female examples in the field of computer science, Frida is a pioneer, namely someone who paved the way for AI in Italy, a woman in a world fully populated by men. In recalling her career, she claims that she has experienced an overall fair environment in terms of gender dynamics, aside from one particular case, when she moved from introductory courses to the "real engineering":

> when the graduate program in computer engineering set out, I moved to the course of AI. Previously, I taught in a course of the biennium, that is an

> introductory course, then I moved to a course in the triennium, namely an advanced engineering course: I felt some hostility in the faculty. Because back then a woman teaching in a course of biennium, why not? There are several women that teach mathematics and physics in the biennium, but in the triennium of engineering… engineers are male, a and woman is perceived, or was perceived in 1990… (Frida, full professor retired in computer engineering, interview)

Here Frida outlines a division of subjects areas — introductory courses and advanced courses — which are informed by gender asymmetries. According to her experience, indeed, introductory courses such as mathematics and physics are likely to be taught by women, but when it comes to engineering advanced courses, like AI, a woman is perceived as an intruder (Gherardi, 1996). Therefore, I asked Frida what is it that makes introductory courses a likely female domain, whereas advanced courses look like a male clubhouse:

> because in the triennium you have advanced engineering subjects like civil engineering. So in the first two years you learn the tools of the trade, right?! Mathematical tools, physic tools and so on. Then you learn the proper techniques of your engineering, these are what I call engineers with capital "i". So I felt some mistrust among faculty colleagues when I had the courage to leave the world of service subjects and enter the world of actual engineers. There are few women who are actual engineers.

This excerpt shows the extent to which Frida has experienced the gendered division of knowledge within the engineering field. In her view, the more it comes to specialized and technical subjects the more the field is male-dominated. However, her reference to the “engineers with capital "I" looks more like a mockery of the dominant gender configuration she found in the triennium than the reflections of a “subjugated feminity” counterpoised to a hegemonic masculinity (Connell, 1987). Nevertheless, the

gendered division of sub-fields remains, with “service subjects” taught by more women in the biennium and advanced engineering subjects which were configured as a male domain.

Frida told me that she perceived this sense of hostility coming not from her students or closest colleagues, but from male professors who taught in engineering courses — such as chemical engineering and Engineering physics — which were “harder” than computer engineering. She attributes this diffidence to the fact that male professors were somewhat unprepared to handle the presence of a woman in their domain during a time when in the triennium there were 3 female professors in a faculty of 500 members. When I asked Frida to explain this supposed distinction between “harder” and “softer” engineerings, she claims:

> well, also in engineering there is the engineer who goes with his hard hat on construction sites and the engineer who goes to offices and sit at the table. The one who goes with the hard hat on construction sites, that's very tough. So it is no by chance that the female presence grows in less tough engineerings. There is a high presence of women in clinical engineering and bioengineering, but this is because of their social value: medicine, taking care of others, and so on. So they have the same success of biology or biotechnology. Here, in the field of information, the graduate program that attracts more women is management engineering because it is without the hard hat.

The figure of the “hard hat” is a powerful one, therefore I asked Frida what this object represents for her:

> in some cases the hard hat is just a metaphor, because in management engineering it has a metaphorical sense. It means hard life, life you live on construction sites, life in an environment where there are only men, in which you have to lead or control a group of men, so you have to be accepted as chief by a group of men, so it is a working condition not that easy, honestly.

> Let's say, to be a forerunner or be alone in certain positions, without models for you and for others around you, without previous examples for those around you, this is not easy.

The hard hat is both a symbolic reference and a material artifact through which Frida describes a strong masculine environment as construction sites are. These are environments commonly associated to manual work, physical strength, risk, danger, noise, dust (Doria, 2014), elements that, in turn, are usually associated to a gender identity that corresponds to the heterosexual, able, working-class male. It is this gendered field with the "hard hat" that Frida describes as hostile in seeing a woman teaching advanced engineering subjects rather than "service subjects". However, it is important to point out that, if she describes some engineering subfields as "harder" than others, she depicts her specific discipline — computer engineering — as a fair environment in terms of gender relations despite the fact that computer engineering is a male-dominated area too. A similar acknowledgement seems to confirm the argument of the social constructionist character of multiple masculinities, by which "masculinities are configurations of practice that are accomplished in social action and, therefore, can differ according to the gender relations in a particular social setting" (Connell & Messerschmidt, 2005).

4.5.3 The "male character" of Wikipedia and "testosteronic desktops": IT artifacts are gendered

In asking "how is technology gendered?", Wendy Faulkner (2001) claims that one of the less obvious ways in which technology is gendered explores gender "*in* and *of*" technological artifacts, where the former refers to the fact the gender biases are inscribed into the design of technologies, whereas the latter has to do with symbolic and ideological associations between gender and computer technologies. These issues have somewhat emerged from my conversation with Maria, who managed a three-years project within Wikimedia Foundation, which is the non-profit organization mostly known for running Wikipedia among its several projects. The criticism about the gender bias on Wikipedia is an issue which has attracted a growing interest in the very recent time (Reagle & Rhue, 2011; Hargittai & Shawa, 2014; Menking & Erickson, 2015) as also the article within the online encyclopedia certifies[34].

According to Maria, "Wikipedia is written by men" since it lacks many articles regarding typical female topics such as popular bags or lipsticks, while it abounds with typical male topics such as soccer: "it is sufficient for a soccer player to have played once in Serie A or Serie B to end up on Wikipedia". According to Maria, alongside episodes of harassment and trolling of female editors, another reason behind the under-representation of women in Wikipedia is due to a lack of user-friendliness in the editing interface. In her opinion, if you are not skilled in informatics it is not easy to edit an article. It follows that there are few women who participate to Wikipedia because generally there are few women working as IT professionals. Thus, according to

[34] https://en.wikipedia.org/wiki/Gender_bias_on_Wikipedia

Maria, a clear bias in the design of the user interface of the platform inhibits female participation as contributors. Consequently, such technical issue engenders a little coverage of topics related to women as far as the Italian language is concerned:

> The article about the lipstick is very short. And for example, many pioneers of computer science are missing. You always find the English article, whereas there is not the Italian article or it is very short. But it's like if female computer scientists do not exist. There is Ada Lovelace, but what about the rest of the world? The fact that women do not write on Wikipedia means that the encyclopedia has a male character. (Maria, interview)

To recall Faulkner's feminist analysis on technologies, the male character of Wikipedia lies both in the lack of user-friendliness in the design of its editing interface and in the contents it conveys. In Maria's view, such gender bias in terms of design and contents makes Wikipedia an artifact done by men for men.

Eva, the Italian co-founder of Italian Ubuntu women, pointed out a similar concern when she told me an interesting and somewhat funny anecdote about the time when she worked full time in the open source communities. The story specifically concerns the development of a new graphic interface for GNOME, which is a desktop environment and a development platform that supports operating systems based on Linux:

> Gnome is an environment that runs on many Linux distributions, not just on Ubuntu, but it is one of the main projects from this point of view. In 2012, a process of full renovation began, leading to Gnome Shell, which is the graphic environment that there is now, which is completely black, absolutely black, anthracite grey. The edges of windows, the above bar, they had a very masculine character. So I did not like that, it was too dark, it was too testosteronic. In response, I sent to the designer exactly the same desktop, but in pink, very pink, totally sugary. He got quite angry with

> me, but this thing made it clear that when you design an environment, you should try to follow things a little bit more neutral. This is not to say that the project has changed for this; however, for example, a number of things were introduced in order to customize a little bit more and then introduce lighter colors, maybe other colors, it has been a slow process. I guess that the person who made it all black has been quite shocked in seeing a fully pink environment. (Eva, interview)

This excerpt unveils several issues. In the first place, it brings to the fore the problem of the nuts and bolts of system design (Faulkner, 2001; Balka, 2000), with particular regard to the issue of user gendered representations in the design process (Rommes, Bath, & Maass, 2012). According to Eva, the total black graphic design of Gnome Shell reminds to testosterone, the androgenic hormone, namely the symbol of an aggressive masculinity. This remark underlines a narrow user representation in the design process undertaken by a male professional, who did not get through a process of reflexivity in learning how the construction of the interface and its potential users are interrelated. In order to spur such process, Eva sent him the opposite version of a total black desktop, namely an ultra-pink variant, just "to made it clear that when you design an environment, you should try to follow things a little bit more neutral". Indeed, Eva's intention was not that of advancing a very feminine version of the desktop as counterpoised to a very masculine one, but rather criticizing in a provocative way the unreflexive process of designing as far as gender issues are concerned.

Additionally, this story unveils the disruptive power of playing with gender stereotypes and dichotomies. The testosteronic black and the sugary pink versions of the desktop epitomize the most stereotypical understanding of gender relations as well as the heteronormative canon through which even computing artifacts are

constructed. Subverting such codes and symbols by playing with them as Eva did helps to reflect upon the presence of a wide range of gender identities and practices, and, consequently it enacts the development of a feature to customize the color scheme.

PART THREE

STS, Workplace Studies and FTS: challenging a gender-based approach to the study of organizations

5. HUMANS AND NON-HUMANS: PROBLEMATIZING BOUNDARIES IN ORGANIZATION STUDIES

5.1 Missing masses in organization studies

In this chapter I shall report on my empirical engagement in an Italian telecommunication company which I have fictitiously called Passic TV. I have elaborated materials from the field through the analytic lens provided by the fruitful intersection of workplace studies and science and technology studies, which emphasizes the role of non-human actors in the process of organizing. In the first paragraph, I shall briefly illustrate such analytic frame by accounting firstly for the contribution of an interdisciplinary approach such as Computer Supportive Cooperative Work (CSCW) to the study of works and organizations. Then I shall turn to those approaches in organization studies that focus on the role of objects. It is precisely the encounter with a specific object — the Tool — that have brought me to problematize the distinction between the technical and social (Heath & Button, 2002), to analyze the social life of things (Mol, 2010), and to explore the nature of the relationships among people, things, practices and structures that the process of infrastructuring entails. I shall conclude the chapter by discussing some troubles my experience of field research in Passic TV has brought about. Such concerns ended up

by questioning the analytic frame I have used to expose my empirical engagement, delineating feminist-informed ways of knowing, which are presented in the next chapter.

5.1.1 Workplace studies: a mundane approach to organization studies

In 2002, the research strand known as 'workplace studies' made its official debut in the sociological realm thanks to the publication of a special issue of the British journal of Sociology[35]. In the introduction, Christian Heath and Graham Button (2002) underline the emergence of a growing corpus of studies focused on work, technology and interaction in organizational environments. More in detail, these studies

> address the ways in which work is ordered and organized in the activities and interactions of the participants and examine how tools and technologies are used as practical matters in the accomplishment of the work of the setting. In this latter regard, tools and technologies range from documents through to complex surveillance systems, from protocols and formal specifications, through to prototypes. In different ways the studies are not only concerned with the social organization of work and the workplace, and the relationship between work and organizations, but also with rethinking the distinction between the technical and social. (Heath & Button, 2002, pp. 157-158)

This corpus of empirical research addresses a variety of settings, from control centres (Heath & Luff, 2000; Bruni & Modè, 2011), to call centres (Whalen J., Whalen M., and Henderson, 2002), from development of prototypes (Suchman, Trigg, & Blomberg, 2002), to scientific communities (Lynch, 2002) and technological organizations

[35] As Heath, Hindmarsh and Luff (2000) clarifies, many studied gathered under the label 'workplace studies' forego the emergence of such definition.

(Zucchermaglio & Albi, 2005). Its analytical influences and methodological approaches are quite different from the traditional sociological references that have informed the study of organizations, although under different terms (see Bonazzi, 2002). As Heath, Knoblauch and Luff (2000) point out in their presentation of the field, workplace studies have emerged in light of debates within disciplines such as Human Computer Interaction (HCI) and Artificial Intelligence (AI) rather than sociology per se, and have informed a growing and heterogeneous corpus of research within the relatively emergent field of Computer Supported Cooperative Work (CSCW). The development of research programmes mainly in the UK, Northern Europe and North America have promoted an effective and cutting-edge encounter between technical disciplines and social sciences and created forums that actively encourage interdisciplinary collaboration between social and computer scientists. Such an approach to the study of work engenders important implications for research and debates within sociology as far as organization studies and social studies of technology are concerned.

The contribution of science and technology studies to the development of CSCW is pivotal, especially for the analysis of failures (Callon, 1986; Latour, 1993) which has called attention to the many cases of unsuccessful implementation of digital information technologies into organization settings (Star & Ruhleder, 1996). On of the most well-known example in this regard is the project TAURUS (Transfer and Automated Registration of Uncertificated Stock), a technical infrastructure designed to move from paper-based stock trading to a computerized system in the London Stock Exchange (Heath et al., 2000). After ten years of effort and millions of dollars spent, the project foundered as it became clear that the system would have never worked as

planned. The growing attention to the problematic implementation of information technologies and computer systems, which are supposed to improve organization activities, has underlined crucial analytical issues revolving around the relationship between the design and users' needs as supposed advantages conveyed by digital technologies are often taken for granted among management and engineers and, accordingly, that organization practices smoothly adapt to new technologies. On an analytical point of view, these examples of failure have remarked a general sociological disregard for how tools, technologies, artifacts feature in social relations, organization activities and ordinary practices of organizing.

Concerns with distributed and situated character of work and human cognition (Hutchins, 1995), technology in action (Heath & Luff, 2004), and the relationship between them (Suchman, 2007 [1987]) raised by workplace studies has thus interesting implications for sociological studies of organization as far as both methodology and theoretical references are concerned. The primacy of empirical investigation over categorical debate as Suchman recalls (2007) and the birth of a new research "genre" such as the ethnography of organizations (Van Maanen, 1979; Bruni, 2003) raise a number of issues concerning organizational theory and research and the study of technology, which involve, among other things, an interesting and fruitful collaboration between social and computer scientists, between academia and industry.

5.1.2 Following objects in organization

Among emerging approaches to field studies of contemporary organizations, Czarniawska (2008) recalls that of "following objects" (Latour, 1996; Pellegrino, 2004; Bruni, 2005). This perspective is usually associated to the increasingly spread employment of actor-network theory (Latour, 2005) in studying organizations, thus it recognizes the fundamental role of artifacts in the accomplishment of ordinary working practices.

One of the fundamental arguments of such position is that non-humans are actants as much as humans, thus they are endowed with agency which intervenes in the web of relations wherein material artifacts are involved. According to Law (1999), indeed, actor-network theory assumes that nothing has its own form outside the webs of relations within which they are located; accordingly, it becomes crucial to shed light on the agency engendered by material-semiotic tools in order to understand technology and the many cases of failure social constructionist approaches have provided. In this regard, Annemarie Mol claims that ANT "opens up the possibility of seeing, hearing, sensing and then analyzing the social life of things – and thus of caring about, rather than neglecting them" (Mol, 2010, p. 3).

An interesting issue raised by the phrase "following objects", somewhat related to ANT's repertoire, is that objects as well as the network into which they are involved do not stand still, but rather they act. As actors, indeed, objects behave in a variety of ways: they collaborate or resist, they can open up or close access as a doors do, they foster standardization of practices (as we shall see in the next section) or mess the work. In the words of Latour, things are "restless, critical, unstable, complex"

(Latour, 1996: 296). Objects have affordances (Hutchby, 2001), meaning that they invite different courses of action and frame the practices by which artifacts come to be involved in the weave of ordinary activities.

. Such an understanding of social events solicits a shift in the methodological approach, which becomes proximal (Cooper & Law, 1995; Giancola & Viteritti, 2014) to actors so as to detect networks and configurations in the making. The proximal view pairs with an emic approach in research, typical of ethnography and qualitative methodologies (Nicolini, 2009; Silverman, 2006; Zucchermaglio & Alby, 2005). It develops a point of view from within social practices and groups, so that the analysis is based on those relevant categories emerging from local contexts and used by actors, rather than those constructed from the perspective of the researcher.

These ways to address materiality in social and organizational life have been enriched and critically reviewed by emergent approaches that investigate technology in contemporary workplace. The focus of the next section is on those viewpoints that revolve around the concept of 'sociomateriality'.

5.1.3 Sociomateriality of organizational life

The spread of practice-based studies in organizational research has brought to the fore the processual character of organizing with a particular emphasis on the role of material artifacts. As ANT points out, social events and things are not stand-alone entities, but rather they are effects of multiple web of practices, humans and non-humans actors. It is precisely the multiple and dynamic entanglements that lump the social and the material together in everyday life to represent the core concern of

sociomateriality. Outlined primarily by organizational scholar Wanda Orlikowski (Orlikowski, 2007; Orlikowski & Scott, 2008; Orlikowski, 2010), 'sociomateriality' is a broad concept that aims at accounting for the distributed and complex configurations that constitute contemporary organizations. Within such a broad scope, this approach has fostered an entire stream of new research based on the so-called "relational ontology", according to which "the social and the material are inherently inseparable" (Orlikowski & Scott, 2008, p. 456).

The development of sociomaterial approach grounds its analytical roots in the critique of the dominant perspectives on technology that, accordingly to Orlikowski, has either been ignored by organizational research or investigated through an "ontology of separateness" (Orlikowski, 2010, p. 125). According to the American scholar, the principal positions on technology can be framed through three distinctive viewpoints: the first one fundamentally disregard the role of technology in organization, the second one technology is regarded as an "exogenous force", while the third one technology is conceived of as "emergent process", that is as an outcome of ongoing social interactions and human interpretations within a given context.

Against this backdrop, Orlikowski argues that the aforementioned perspectives are fundamentally weak if they have to account for emerging technological transformations in organizations that gave to do with the increasing implementation of social media, virtual design, assistive robots, digital mobility and forms of "algorithmic agencies" that act autonomously as if for global financial markets. These phenomena require a novel analytical equipment in order to be grasped. The relational ontology (Knorr Cetina, 1997; Barad, 2003; Latour, 2005) nurturing the concept of

'sociomateriality' does not treat humans and technologies, as distinct realities, but rather it sustains that the social and the technical are ontologically inseparable (Introna, 2007). The analytical and methodological challenge that sociomaterial stance poses is its understanding of configuration of humans and technologies as embedded and enacted in practices, thus they are changing, fluid and multiple in space and time. It follows that also traditional research techniques need to be reassessed in order to provide reliable empirical accounts of sociomateriality in social life.

5.1.4 Infrastructure and infrastructuring

Concepts like 'convergence', 'intersections', 'cooperative and distributed activities' usually couples with that of 'infrastructure' (Star & Ruhleder, 1996; Star, 1999; Bowker & Star, 2000; Jackson, Edwards, Bowker, & Knobel, 2007; Mongili & Pellegrino, 2014). In the attempt to provide a definition of 'infrastructure', Star & Ruhleder, (1996) shift the pronoun from 'what' to 'when'. Indeed, instead of asking "what is infrastructure?", the authors turn to the more intriguing question "when is an infrastructure?". Behind such rhetorical move, there is an interesting analytical insight. By using the time-relative pronoun, indeed, Star and Ruhleder want to put emphasis on the processual character of infrastructure, that is not just a pre-given thing with attributes frozen in time, but "something that emerges for people in practice, connected to activities and structures" (Star & Ruhleder, 1996, p. 112). According to the authors, the common metaphor that describes infrastructure as something "out there", sinking in the background, as a railroad system or the Internet, is problematic insofar as it does not shed light on the relationships among people, things, practices and structures. Drawing

on Bateson's model of levels of learning, the two scholars argue that infrastructure is in fact a relational concept, never a thing. The emphasis, then, is put not of the "being" of infrastructure, but to the more ecological viewpoint "becoming" an infrastructure, which underlines changes in infrastructural relations, rather than single individuals or causal factors. This process of emergence reveals infrastructures as being: embedded, transparent, defined by their reach or scope, learned as a part of membership, linked with conventions of practice, embodying standards, built on an installed base, visible upon breakdowns, fixed and changed in modular increments, not all at once (Star & Ruhleder, 1996; Star, 1999).

In a similar vein, Jackson et al. (2007) emphasize the historical, thus temporal, character of infrastructure. In reflecting on the attribute of "newness" through which cyberinfrastructures are usually framed, the authors argues that it is also possible to investigate cyberinfrastructures according to a different timeline — that of the "long now" — as well as the general category of 'infrastructure'. Such an understanding, then, remark again the process of naturalization and forgetting infrastructures, which in fact appear "dull, flat, and still" (Jackson et al., 2007). On the other hand, the invisibility of infrastructure poses challenges as to patterns of change and dynamics that characterize the development of many infrastructures.

In this regard, a growing body of literature engages with a processual (in-the-making) perspective on information Infrastructures (Karasti & Baker, 2004; Le Dantec & DiSalvo, 2013; Mongili & Pellegrino, 2014). As Mongili and Pellegrino claim, indeed, "Infrastructures are not static and immobile in time and space: they need maintenance and repair, which become an important aspect of their use as well" (p. xxi). In arguing

for an idea of infrastructure as a boundary phenomenon, Mongili and Pellegrino shed light on the intersectional character of infrastructures, which involve users, machines, designers, standards, practices and design approaches. According to the authors this is probably the densest sociological aspect to tackle.

In an organization such as Passic TV the changing nature of infrastructure and the process of infrastructuring become central by looking at the role of technology and materiality in coordinating collaborative work practices.

5.2 Organizing in Passic TV

5.2.1 The organization chart

"Passic TV is the on demand TV of Passic Network" is the claim that accompanies the opening of Passic TV's webpage. Such a slogan is rather meaningful insofar it provides important information that helps to recognize the brand identity (Floch, 2002). Passic TV, indeed, is not an autonomous organization, but rather it is part of a much broader environment called Passic Network, an Italian telecommunication company which provides telephony services, mobile services, and DSL data services. As a matter of fact, if we scroll the webpage of Passic Network, we find Passic TV out of the set of products, services and solutions for families and private costumers. It follows that Passic's customers benefit from special rates —if they subscribe to the service— and conditions as they can use smartphone and tablet by getting connected to Passic

mobile network, whereas other customers can use the service only through a Wi-Fi connection.

To get an idea of the size and proportions of the network, it is worth mentioning the number of employees working in the company: 53,000 are the men and women working all over Italy across offices, research centers and innovation laboratories, 150 thereof are employed in Passic TV. As outlined in the previous chapter, Passic TV is part of a broader set of services called 'Passic Entertainment' that constitutes the digital contents of the consumer branch of the network. To help clarifying the structure I have just described, I add below the official document containing the organizational chart[36]

[36] I have deleted all the names including in the original document for reasons of confidentiality.

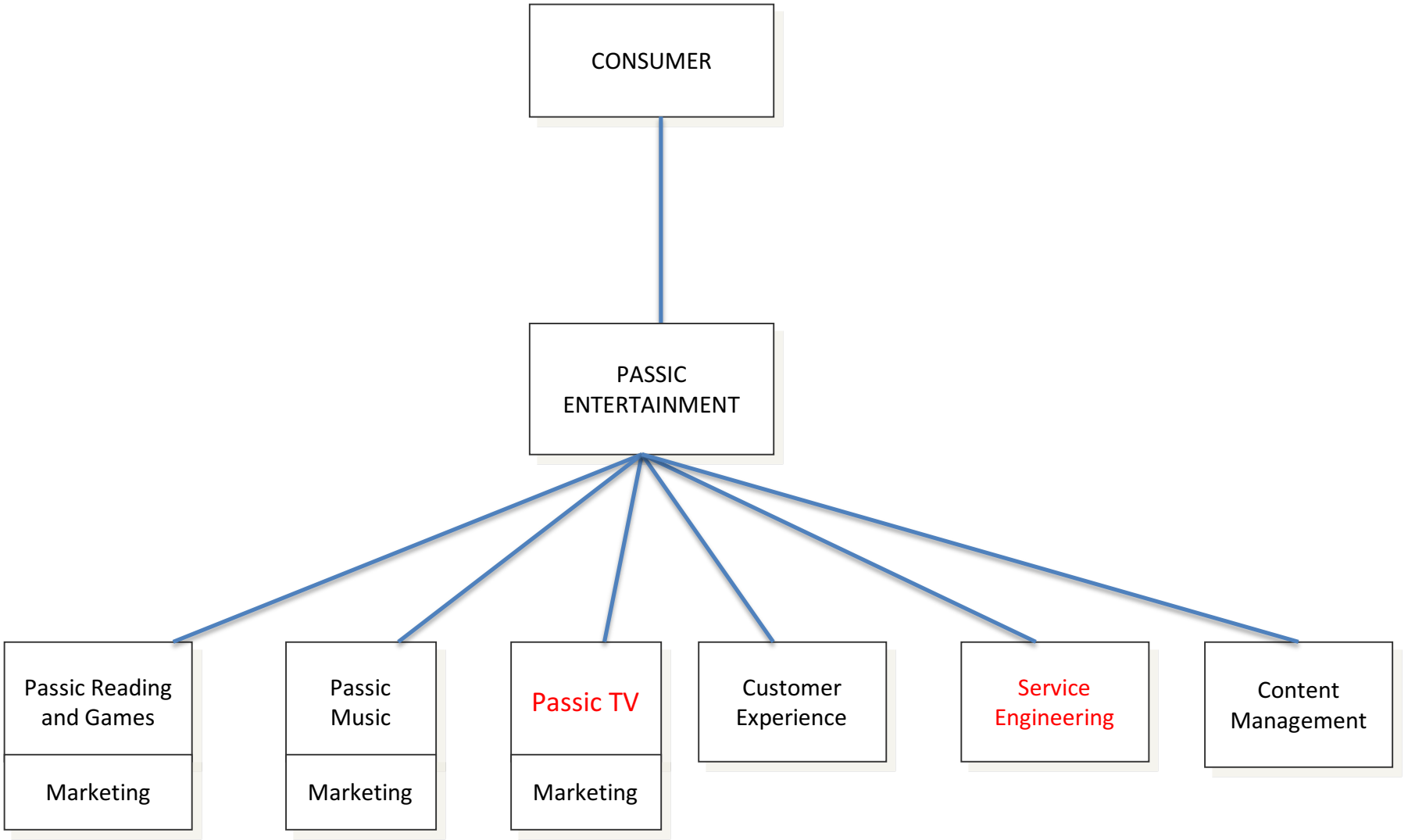

Figure 6. Passic TV's organization chart

As this scheme points out, each digital service within Passic entertainment has its own marketing office with a related person in charge. As the official document states, the marketing function carries out “market analyses, the development of the product portfolio as well as the definition of market plans”. The ‘Customer Experience’ “ensures the integrated management of the customer experience and the definition of the guidelines on the development of new features for all entertainment services”. ‘Service Engineering’ provides “the availability of content, products, services and platforms and its assurance through the definition of technical and performance requirements and the consistency check of the solutions implemented by the relevant structures”. Finally, ‘Content Management’ “ensures the monitoring of all aspects related to the publication of the video content, guaranteeing the content acquisition, programming and marketing, management of metadata and content consistency check” (from Passic’s documents).

The overview of Passic TV organizational areas is a good starting point to unravel the kind of work that is carried out within this organization, the structural conditions that affect work performances and, therefore, the analytical concerns such issues raise and which we shall see in more detail in the following sections. In the first place, as an on demand TV service delivered across different devices, Passic TV mobilizes an array of expertise, technologies, and forms of organizing that can be subsumed under the label ‘knowledge society’ (Drucker, 1969; Bell, 1973; Gherardi, 2008). Such phrase describes a set of important transformations that since the 1970s have made knowledge and learning the most crucial drivers of the economy and a critical asset within the competitions among individuals and organizations. These changes have of

course affected also the organization of labor, particularly regarding qualifications of workers, the ways through which to manage labor processes, the relationship between competences and job positions within the so-called 'broad professions' (Butera & Di Guardo, 2011). Passic TV is an organization playing within the market of digital contents and streaming on demand, thus providing a cutting-edge service similar to those developed by companies such as Netflix, Amazon, and Hulu. At the same time, Passic TV is not a stand-alone organization, being it part of a broader and much older network whose governance grounds its roots in professional bureaucracy characterized by tight procedures and widespread forms of control (Mintzberg, 1979). It will be interesting to investigate, then, how the coordination of work that the organization carries out, which is very often represented as "emergency" or "chaos" by the actors, has to deal with a highly structured processes. I shall particularly focus on the work of processsing contents as it is the one undertaken by the production group, which is part of the service engineering area. Most of my ethnography, indeed, has taken place within this team, which is physically located in a separate place from marketing, customer care, and content management branches. Such a note is by no means trivial as it puts forth two interesting issues: the need to develop appropriate tools supporting cooperative work among groups that are physically separated, and the organization of space which, at a closer look, reveals a mutual shaping between the aesthetic configuration of space and the division of labor. In order to deepen these issues, it is helpful to outiline the process of contents processing, which runs from their acquisition to the final stage of release.

5.2.2. Passic TV and Passic Network: a problematic legacy

As illustrated in the previous section, Passic TV is a relatively young company whose identity is fiercely marked by those values and rhetorics typical of the Information Age: 'innovation', 'profitability', 'sustainability', 'digitalization', 'connectivity', 'young people', 'well-being'. At the same time, the company is in fact a digital product of a broader box (Passic Mobile), which, in turn, is part of the much older Passic Network. The latter belongs instead to an organizational thinking and structure highly hierarchical and bureaucratic, with a clear division of labor that tends to structure labor processes under the separation between professional work and mechanical work, a configuration similar to the one that Mintzberg has defined 'machine bureaucracy' (1980). The conflict between these two different ways of structuring labor processes and relations is often emphasized by the people I have met during my fieldwork:

> We are in a company that is not hyperflexible because it is a big and hyperstructured organization, so speed and dynamism are not the main features of Passic Network. Therefore, all our activities enter into a process that has its own entry point and an exit point as well as a rigid temporal development, so we can hardly change the process when this starts. Therefore, if I have to say now what I will do in June, I have to be able to predict and limit intervention to a minimum during the process, because response rate is not instant. […]
> Unfortunately, the history of Passic TV is related to that of Passic Network. An innovative business in an organization that has not an innovative DNA takes time. We are not Google, Netflix or Facebook, which instead are business born with the new economy and that have developed an approach to organizing totally different from the standard. It's like if you're in a company that has a certain dose of conservatism, has always worked in one way, has always managed the business in a certain way, it has always equipped itself with hyperstructured processes and a hyparcelization of work, then it's hard to imagine an organizational model in which some layers flatten out and

> there is less stiffness from one access point to another. (Angelo, acquisition and content manager, interview)

In this interview I ask Angelo to reflect upon the difficulties affecting the distributed work that drives audiovisual contents from entering the organization chain to their broadcasting. More specifically, I wondered how an innovative service as Passic TV is supposed to and claims to be face many difficulties to be accomplished, to the point that chaos and emergency become the ordinary work to deal with. In his reflection, Angelo points to the legacy of older systems and organization structure, characterized as stiff for its strict and fragmented division of labor.

This controversial relationship between Passic TV and its progenitor has often come up when I ask my interviewee what Passic TV is:

> Passic TV is a bet, perhaps lost. We started on time with all the energy needed. I work with television on Internet since ten years. We started 10 years ago with the ADSL TV, I was there. We could do so much, there have been many investments, but frankly, there has been a management that had no clear goal or probably the goal was clear but did not coincide with the launch of the service. (Silvia, former production team's coordinator, interview)

Silvia's words, as many others I have listened to during my research, disclose a certain degree of dissatisfaction with the actual state of the service. More specifically, the mismatch between the amount of investments that Passic Network did ten years ago when the service started and the lack of a clear vision on which to develop the service itself is regarded as an almost lost bet. This account, as well as that of Angelo, can be enlightened as a clash between different sociotechnical systems that coexist in the same large organization: the first one is Passic Network — which is a

telecommunication company that provides phone landline services and mobile services — whereas the second one is Passic TV — which is an on demand television operating within digital market. As Thomas Hughes (1989) points out, components of technological systems are physical artifacts (such as turbogenerators, transmission lines, cables, satellites etc.), organizations (such as telecommunication companies, banks, universities etc.) with their own material and knowledge objects (books, documents, research programs etc.), and legislative artifacts (such as regulatory laws, standards etc.). Of course, each component of a technological system interacts with other components in a way that is supposed to be coherent and controlled:

> Because components of a technological system interact, their characteristics derive from the system. For example, the management structure of an electric light and power utility, as suggested by its organizational chart, depends on the character of the functioning hardware, or artifacts, in the system. In turn, management in a technological system often chooses technical components that support the structure, or organizational form, of management. More specifically, the management structure reflects the particular economic mix of power plants in the system, and the layout of the power plant mix is analogous to the management structure. The structure of a firm's technical system also interacts with its business strategy. These analogous structures and strategies make up the technological system and contribute to its style. (Hughes, 1989, p. 52)

Hughes clearly identifies the link that makes a particular management structure, organizational form, business strategy and technological artifacts a system, namely a coherent and unitary arrangement of different actors that interact with one another. If we read Silvia's words through the functioning of sociotechnical systems provided by Hughes, we can conclude that the configuration of Passic Network's system is somewhat incompatible with the one a business as Passic TV would require. If Silvia

puts emphasis on management business strategies, Angelo faces the same issue in slightly different terms:

> Sometimes the organization of your job unfortunately is grounded on the organization of your company. So, we are not a TV company, let's say we manage a TV business embedded in a telecommunication company, which has a totally different way of organizing itself. This company looks forward with the approach of preserving the past, because this is an incumbent company, that is it holds a dominant position on the telephone market for example. Being incumbent definitely gives advantages, but also a certain passivity. (Angelo, acquisition and content manager, interview)

According to Angelo, Passic Network and Passic TV are not different organizations. His claim, "we are not a TV company", indeed, means that he regards the two organizations as the same structure despite the fact that they manage two different businesses — telephony and TV. The oldest one — telephony —comes to thwart the youngest one and, for this reason, its vision of the future is necessarily encumbered by the components of the old technological system.

Behind the rational account of the organization conveyed by the organization chart, Angelo and Silvia's accounts betray a lively and chaotic process of organizing within Passic TV, which struggles against the resistances of its progenitor. In the next paragraph, I shall deepen some of the main features that characterize working in Passic TV.

5.2.3 Framing work: emergency and chaos

In her discussion about the various approaches to the study of organizations, Gherardi (1995) introduces the trope of 'dragon' to articulate a cultural and symbolic view on

the processes that regulate the organizational life. The picture of the dragon behind the organization chart — which Gherardi draws from the Standing Conference on Organizational Symbolism (SCOS), an autonomous working group of the European Group for Organizational Studies[37] — represents a paradigmatic shift from rationalist and functionalist analysis of organization. According to the Italian organization scholar, the dragon unmasks what the organization chart hides, namely the chaos, the ambiguity, the becoming, the eternal flux, the shift registered in organization studies from organization meant as structure to a focus on the process of organizing.

Far from regarding culture as an object whose properties are to identify (Schein, 1985), Gherardi argues that the phrase 'cultural approach' refers to a performative approach — rather than an ostensive one (Latour, 1986; Czarniawska-Joerges, 1991) — to the investigation of organizational culture, that is to say it looks at culture as a set of meanings produced and reproduced through social interactions rather than considering just the definitions provided by actors. "Organizational culture is thus an outcome that involves as much its producers as its consumers and researchers in a social construction of meanings which is intentional, reflexive and indexical" (Gherardi, 1995, p. 25, my translation).

The symbol of the dragon that rips up an organizational chart, a visualization of the organization rationality, conveys all the ambiguity and dualistic character that every symbol naturally embeds: on the one hand, the dragon represents the ambiguity behind the organization culture while, on the other, it points to the practical knowledge (Lave & Wenger, 1991; Wenger, 1998) that is peculiar of each organization

[37] Standing Conference on Organizational Symbolism, http://www.scos.org/

as it involves a repertoire of ideas, commitments, technologies, routine and documents. At the same time, as Gherardi notices, the dragon also constitutes a challenge, a sort of intellectual disquiet for the researcher in the moment s-he goes beyond rationalist explanations of organization in the attempt to investigate the "underground", the "backstage", the informal practices or, rather, how dichotomies such as formal/informal, top-down/bottom-up, project work/operational work come to matter (Barad, 2003).

When I entered Passic TV to undertake my research, I have quickly realize how 'chaos' and 'emergency' were the two common words used to describe the organization and the process of organizing. The ambiguity and difficulties of organizing, in other words, were not something to be discovered, but central part of the customary accounts about the work provided by actors, thus inevitable issues to grapple with as a researcher. Here is an example of how actors in the field describe their daily work:

> Beatrice organizes our job, she directs everything, plans it and let us know the deadline. This happens, let's say, in moments of calm; however, more often, as in this moment, we have to work in the so-called "slide tackle", today for tomorrow, and we'll try to re-plan every day. (Nadia, content editor, interview)

As Czarniawska explains (1997; 2004), organizational discourses and narratives — that is, in this case, the ways whereby people account for their work — provide crucial insights into and about organizations, showing practices, values, habits and belief characterizing a particular organizational culture. On a similar note, Bruni, Gherardi and Poggio (2005) distinguish between "discourses as artifacts" and "discourses as

processes" (p. 142); if the former consider discourses and narratives as objects, products and indicators that identify dominant values and norms, the latter call into question the actual process of narrating, focusing on the rhetorical choices whereby collective memories and processes of identification are constructed. In this excerpt, Nadia mentions a practice of work called "slide tackle", which refers to situations of emergency wherein the group has to re-plan the work day by day due to unexpected events. The "slide tackle" is a metaphor drawn upon soccer language and points to one of the most controversial play completed with one leg extended to push the ball away from the opposing player. It can be a source of controversies as quite often players being tackled fall down over the tackler's foot. The tackle, then, is meant to interrupt the player's race towards the opposite goal. In a similar manner, the unexpected event is considered a "slide tackle" that interrupts the course of activities as scheduled in the program plan. The unexpected events can concern both internal of external issues, technical or organizational. Here is an episode recounted by Silvia:

> It's an emergency job, an urgency job. It is like that for many reasons, both structural and for the job itself because you can have an unexpected event that messes the schedule up and you have to sort it out in an *agile* manner, as it's trendy and cool to say now, in order to ensure the outcome. The latest example is the strike of voice actors, which has seen us receiving contents that, based on rights and the agreement, should go on the air on July 24 if I am not wrong. So there is no more time to work these contents smoothly and then of course we have to reschedule the whole planning of processes in order to ensure the airing of such contents. Then, unfortunately, there are other emergencies due to bad communication, a non-optimized management of the entire workflow. An example of bad communication is when they forget to tell us something and then remember it 15 days before the airing. (Silvia, former production team's coordinator, interview)

As Silvia points out, the unexpected events that mess the schedule up can rely upon different circumstances that in part are unpredictable (the strike of voice actors), but sometimes they depend on organizational shortcomings such as “bad communication” or “a non-optimized management of the entire workflow”. However, what is interesting of this passage, along with the other one by Nadia, is that unexpected events are constitutive of the ordinary course of activities and, at the same time, they are defined as emergencies, that is something extra-ordinary, exceptional, potentially disruptive. There seems to be, then, a mismatch between the frameworks that actors employed to define their experience of events at work (Goffman, 1974) and the assumptions about the supposed linear and orderly chain of organizing.

Such understanding of work in Passic TV is somewhat respecified by Dario when I ask him to reflect upon his constant use of the word “chaos” in his accounts about working in that organization:

> ‘chaos' is all that is not determined by a process. You have to bear in mind that in a company like this, especially in multimedia, therefore technology and communication, everything is defined by processes, in the sense that activities that go beyond the process are not predicted, because everything has to be scalable and penetrable. Is there a problem? I know whom to call on to sort it out. Penetrable means that there is a problem and I know where to go through in order to solve it, everything must be coded. So chaos, that is working in a chaotic way, means that when I have a critical issue I don’t solve it within the workflow nor I stand still, but I go about it through a non conventional way, any type of critical issue. (Dario, project manager, interview)

Here the reference to organizing through a hyper-structured configuration of processes comes back when Dario describes the way working is defined and organized

in Passic TV. The need to make each process “scalable” and “penetrable” that Dario mentions reminds to Frederick Taylor’s theory of scientific management, which has seen new forms of application in the so-called “knowledge society”, a phenomenon commonly known as “digital taylorism” (Bonazzi, 2008). In this regard, standardization and routinization of processes through different technologies are constitutive of the workflow, whereas ‘chaos’, in Dario’s words, means working in a creative way, outside the general course of activities, especially when employees have to deal with a critical issue. The need to standardize workflow through computer technologies is one of most pressing issues in Passic TV. The next paragraph is thus dedicated to deepening it.

5.2.4 From acquisition to release: the sociomaterial life of a digital content in Passic TV

As suggested in the previous paragraph, each digital content that enters the realm of Passic TV has to pass through a number of stages which redefine it under legal, material and technical terms. I use the words of Laura — current service development manager in the customer care area — to describe such process:

> The process leads to the acquisition of content rights all the way to the actual realization of the package, that is the publication of contents for which you get the rights. So, you move from a phase of acquisition, programme scheduling, and then there is a more operational part of multimedia to be added, and the content setting as it will be like in video. I prefer to make a comparison. Let’s assume you are a writer, so there is the writer who writes the book, then he submits the book to a publishing house which buys it, but then it needs to print it, to package it, to price it, to know how much is it, to put an IBI code, to make the cover, and other things. (Laura, service development manager, interview)

This excerpt reveals some important components that specify the multimedia content that Italian and international film studios (called "content providers") sell to Passic TV. In the first place, the content management branch defines the TV's package, namely they decide what contents (movies, documentaries, kids' programmes, TV series, live concerts and others) will air on the platform[38]. Such decision is strongly related to the terms upon which the company reaches commercial agreements with film studios. Contents' acquisition, indeed, is ruled by legal rights that establish for how much time and under what commercial requirements Passic's package will feature audiovisuals. Some of them indeed are sold standalone, in the so-called "videostore", while others are offered to customers who take out a subscription. Additionally, the license for commercial use is temporary, so each content has a start date and an end date for its online display. Once content acquisition is finalized or just in progress, the titles are put in a file Excel, called 'program plan', which contains information about licenses and the time window for broadcasting. As Beatrice — traffic manager[39] — explained to me, <<when content managers close a contract, in theory they are supposed to update the program plan and say "we have bought Mad Men 7 and it goes on air in December. It will run on videostore, decoder, smart TV, but not on iOS because we don't have license for it", for example>>.

Once licenses are acquired, contents are delivered to Passic's offices via digital transfer or analog videotape such as Betacam. At this point, the production team

[38] The current offer include over 10.000 titles.

[39] Traffic manager is a figure in-between that connects the content management area, the production team and studios which produce and sell products. In Passic TV, it is involved in the bargaining stage, then it ensures the on time and orderly flow of content processing, from the physical acquisition to product completion.

enters the scene as it carries out the task of encoding contents. If they are delivered in the Betacam format, they go through the process of ingestion, namely they are transferred to the hard disks and then digitalized. After the ingestion, the process of encoding starts. Ludovico and Nadia are two of the four people who carry out the process of encoding as well as that of editing contents. They describe “encoding” as <<converting contents into different profiles according to the specificities of different devices — decoder, Android, Xbox and Apple>> (interview). The encoding phase is often depicted as a <<manual and repetitive task>> (Leonardo, interview), and it requires a growing amount of work as both contents and devices increase over time, thus it is — as we shall see in detail in the next section — one of the tasks involved in a process of automation on which the service engineering is at work. Besides this task, the production team also works on making original contents’ trailer, that is they do not use specific materials they receive from content providers, but they draw scenes directly from the movie. Once all profiles are ready, they are uploaded upon a digital platform wherein they are associated with a sheet reporting a number of editorial information called ‘metadata’: overview of the content, title, genre, director, actors. Such document also reports the various ways of consumption as well as the forms of subscription suggested by the program plan. As soon as contents are provided with all of these components just been described, they go through the stage of publication and, finally, online. After the release, another process sets out with the various types of control that a group of people carries out to verify that all the audiovisuals have been published, are visible and ordered. The phase of publication monitoring is the last part of a sort of virtual assembly line that never stops. To better depict the chain of

acquisition, production, publication and monitoring of contents, I offer here a graphic representation:

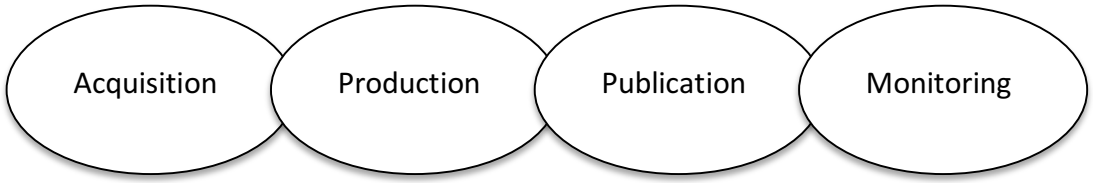

Figure 7. Chain of contents processing

This job of contents processing is just one of the many processes that I have intercepted over the course of my study and that characterize a hyper-structured company as several actors whom I talked to have defined Passic TV. Having focused most of my research on the activities carried out by the production team, I then shall deepen some issues regarding contents processing, trying to delineate how it interacts with heterogeneous elements under the terms of what John Law has defined as "heterogeneous engineering" (Law, 1987).

5.3 Collaborative work and technological innovation

5.3.1 The problem of coordination: the role of technology

As described in the previous section, the work of acquiring, processing and releasing contents in Passic TV is a collaborative effort undertaken by different communities which are physically located in separate places. The activities of information,

communication and coordination of such workflow through information technologies is thus pivotal in order to accomplish such cooperative tasks. After all, the complexity of coordinating cooperative activities in organization settings has been noticed from the outset in the history of CSCW:

> The new capabilities at which coordination technology aims depend on finding and installing appropriate conceptual and structural units with which to express tasks, their diverse relations to each other and to the people who ultimately bear responsibility for them. To be useful, this must be done in a flexible yet well-integrated manner, with plenty of leeway for the unpredictability of real life. (Holt, 1985, p. 281, quoted in Schmidt & Simone, 1996, p. 155)

I have come to realize the crucial role of communication and information retrieval since my early observations within the production group, the community wherein most of the fieldwork I have conducted in Passic TV has taken place. Its job basically consists in editing audiovisual contents (movies, TV series, cartoon, documentaries), allowing them to run on different devices (TV, PC, smartphones, video game consoles) along with that of creating original contents' trailers. This group is commonly considered as the most technical and operative area of the content processing chain, to the point that the current group coordinator — Bruno — told me that in the past this "technical rib" was part of the technology and operative division.

I began my research at the end of February 2014, when the group was made up of 10 people: 4 content editors (Ludovico, Pietro, Luigi, Nadia), 1 product manager (Viviana), 1 project manager (Leonardo), 1 Web engineer (Carlo), 1 project manager

(Dario), 1 traffic manager (Beatrice), and 1 content and multimedia manager (Silvia)[40]. Since my first observation, I have registered that one of the most pressing issue for the group was the construction and implementation of a tool for workflow management.

Figure 8. The production group during a meeting

[40] The group has gone through several changes during my stay in Passic TV. At this moment I am writing, the most significant shifts have affected the head of the team (from Silvia to Bruno), and Dario, who no longer works there. Moreover, two more people have joined the group in the last weeks, and Beatrice is waiting for changing her position and going to work in another area.

As explained in the previous paragraph, the way people in Passic TV, and especially the production team, portray their ordinary work is usually connoted by the words “chaos” and “emergency”. Such recurrent situation often has to do with time management along with the widespread belief that the unit is undersized. The amount of work that the group handles has in fact increased along the years due to the growing and increasingly diverse production of contents (for example TV series) on the one hand, and to the growth of Passic TV as digital service. Despite such expansion, the personnel has not increased, with consequences for work management. Additionally, as both the former and the current coordinators of the group — Silvia and Bruno — point out, the group is directly affected by the unpredictable dynamics of creative contents. As Bruno puts it:

> Recently, especially over the last year, the content acquisition group has reported to us that they are having great difficulties in closing the agreements well in advance due to market demands. You know, according to the workflow we have agreed upon with the other actors of the process, the program schedule should be delivered 40 calendar days before the online release. This never happens. But not because there is someone who wants to be bad, but because, as the content acquisition chief explained to us, since Netflix enters the market, content providers, that is those who own content rights (“Frozen” for example), before giving the license to Passic TV, wait until the last minute because maybe they hope it gets Netflix or another company that takes the exclusive license on “Frozen”, by paying a lot of course. Clearly, although the content management area tries everything to get the license of “Frozen” perhaps three months in advance, maybe Disney plays for time and doesn’t answer. So we get to December 1, with the schedule saying that “Frozen” must be online on December 8, and we complain because it’s in the program plan but we don’t have the multimedia yet because they don’t have close the agreement yet, but maybe they close it in the nightime. So, we have to rush to call Disney and ask for the multimedia. Disney will have its timing to send us the multimedia, then we have our timing for processing contents, and it ends up we can’t make it. It’s a rush, so the difficulties have to do

> precisely with timing. (Bruno, content production e publication monitoring manager, interview)

The growing presence of new competitors and new creative contents on the market has thus engendered important consequences for the work of Passic TV, whose technical infrastructure and personnel have instead undergone little transformation. Against this backdrop, it does not come as a surprise that one of the most important activities involving the production group, along with other areas, is the improvement of technical tools so as to make more effective the process of coordinating the work.

The presence of an external consultant — Carlo — in the group owes precisely to the demand of building a tool for the workflow management, with the specific goal of facilitating the management of contents. In the next section, I shall illustrate in more detail the process of designing the tool and the difficulties its stabilization is facing.

5.3.2 The Tool or Penelope's web: the bumpy ride towards stabilization

During my participation at the production team's weekly meeting, I have identified two organizational main tasks involving the group: on the one hand the development of an automatic encoding systems for contents, on the other the design of a tool for workflow management. As I have come to learn later in the fieldwork, these projects are interrelated as the tool, besides being a database of contents' information, is supposed to work in order to assemble the final product, namely to put the multimedia encoded and its editorial data together.

When I began my research (February 2014), the project of developing this digital system was in its early stage and its design undergoing several problems which can be summarized as both technical and organizational. Carlo was the Web engineer who has been hired in July 2013 as technical adviser with the specific task of developing the tool. According to him, this artifact is a "coordination tool, used on the organization Intranet, with a Web interface, that allows the contents workflow management" (Carlo, interview). The tool, indeed, is a digital artifact that is supposed to take over the several Excel spreadsheets — such as the "program plan" and program schedule — that are currently used to coordinate the work among the various areas. The organizational difficulties in achieving a stable design configuration, indeed, rely on the diversity of requirements each group brings up. These uncertainties about the final outcome are evident from the lack of a proper name for the tool and the search of it as this funny list shows:

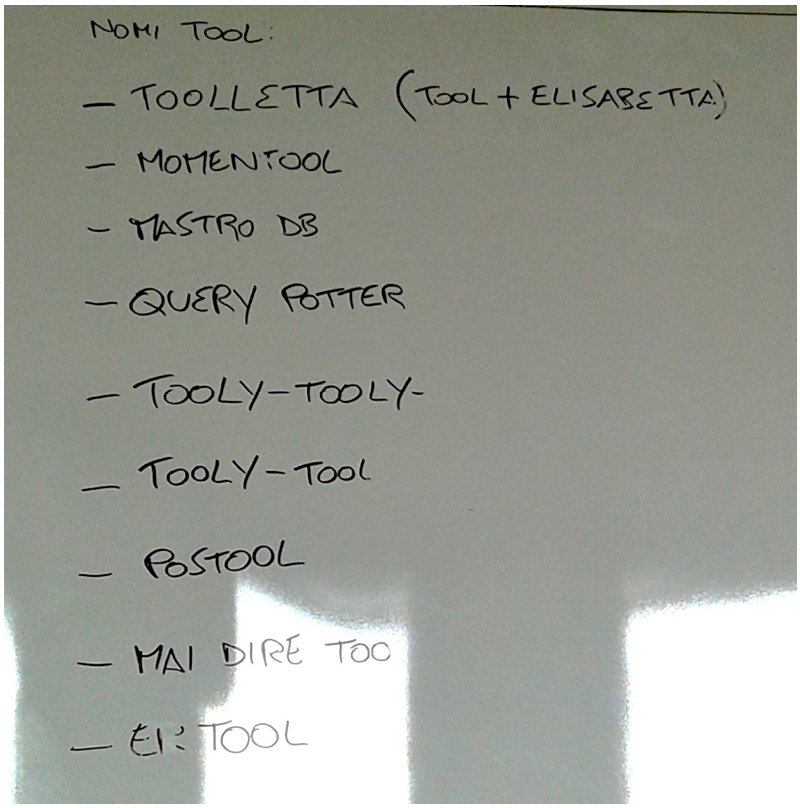

Figure 9. Whiteboard with potential names of the Tool

This whiteboard shot I took in the production team's building ironically reveals what the tool is supposed to be in reality — a "Mastro DB", that is a "Master DB", a big database wherein to record all the information about thousands of contents — and what the group dreams of it to be in an ideal world — a "Query Potter", namely a magical data recovery able to provide in the easiest way possible the proper results to any query about contents. Additionally, with a grain of imagination, the moniker "mai dire tool" ("never say tool") betrays the multiple interpretations, demands and potential uses the tool tends to attract.

In this regard, Trevor Pinch and Wiebe Bijker (1984) define the cultural construction and interpretation of technological artifacts as 'interpretative flexibility'. With this, they "mean not only that there is flexibility in how people think of, or interpret, artifacts, but also that there is flexibility in how artifacts are *designed*" (Pinch & Bijker, 1984, p. 421, emphasis in the original). According to the authors, the different interpretations of a technological artifacts provided by different social groups does not simply refer to how the social meaning of the artifact depends upon the context where it is employed, but rather they concern the *content* of the artifact itself. By "content of the artifact", they imply that different interpretations do not merely involve the phase of consumption, be it active or passive, but they point to different chains of problems and solutions, leading thus to different further developments of the artifact itself. Pinch and Bijker offer an empirical investigation of such dynamics by studying the development of the bicycle.

A similar situation seems to affect the development of the tool in Passic TV. Oftentimes, indeed, Carlo has compared its work of building such artifact to the Penelope's web, that is something that is a perpetual work in progress, constantly undone, but never done. According to Carlo, the only way for the tool to work out and be really effective considering the design requirements is that all the areas involved in the chain of contents processing will use it. When the projects started, indeed, not everybody was convinced of its potentials, but now — Carlo says — people seem to recognize it. In order to understand the function of this artifact, it is worthwhile to delineate its history and genealogy as we shall see in the next section.

5.3.3 The Tool as database: searching for coordination

As said previously, the amount of information regarding contents has significantly increased over the years in Passic TV. For this reason, a tool for managing, storing and sharing such information has become a pressing need especially for the production team. The study of technologies capable of supporting groups of people in the workplace is at the core of an entire interdisciplinary field called of CSCW (Grief, 1988; Suchman, 1989; Bannon & Schmidt, 1989). This research field investigates how computers and ICT technologies used and might be used more effectively to support people in their various work arrangements (Mills, 2003). At the core of CSCW's interests are then collaboration technologies, both real time and asynchronous, from telephone to e-mails, from database systems to document repositories, from workflow management tools to virtual worlds, that involve not just cooperation, but also conflict, competition, or coercion (Grudin & Poltrock, 2012).

As explained by Silvia and the group, the demand for a tool of workflow management has arisen from the need to rationalize the management of information and take over Excel spreadsheets:

> the tool has been something that I've wanted to introduce because for me it was crazy send each other information via email. It should be used to manage what we do, that is to work on the lifecycle of contents in a systemic manner. It's a database. Such a need has long been known, however nobody has been ever worried about this, except in the case of the former coordinator, who had created a homemade tool but that did not supply all the needs we have. The crazy thing is that the flow of information kept going to be managed via email and this is something insane to me, given also my experience in a previous company. So, as soon as I had the opportunity, I've thought to set up a database that was queryable with different graphical interfaces. Depending on where the content is located, the person who at that time must manage a task on the content enters, checks the status of the content, carries out his task and update it, so that the chain is managed in a fully automatic way, without this communication overflow that in 2014 is insane, just work wasted. We can not rely upon hallway chatting, on the email sent out, or the phone call. We manage a list made up of 5.000 contents and every month we do a miracle to handle it as we are hadling now, with Excel sheets. Every month is a miracle that everything is online, because communication is very loose. (Silvia, former production team's coordinator, interview)

This excerpt is meaningful insofar as it brings up two issues regarding the function and the development of the tool. As Silvia points out, the tool is a database to manage contents' workflow and information that were, and in part still are, processed via email and Excel sheets. On the other hand, Silvia points to a proto tool that was arranged by the previous coordinator, a "homemade tool" that did not suffice anymore to the amount and the increasing complexity of the work undertaken.

Maintaining a shared awareness of the information and potential changes regarding contents along with detecting them easily seem to constitute the main

requirements that, according to Silvia, the tool should fulfill. Her resolute decision to have an object able to manage the work in a "systemic manner" let us sense how material artifacts are part and parcel of daily organizational practices as well as their active role of materiality in constructing order and accountability (Bowker & Star, 2000; Heat & Luff, 2000; Orlikowski, 2010). In other words, according to Silvia the tool is meant to be a resource able to rationalize some courses of action and, at the same time, be accountable for them. Accordingly, the reason why she finds "crazy" and "insane" managing a similar amount of information through email, Excel sheets, phone calls and informal chats relies on the fact that such technologies do not reduce the degree of ambiguity, gaps in communication and conflicts that such a job inevitably brings out to the extent that accomplishing the job every month becomes a "miracle", namely an extraordinary and hard-to-reach outcome. The particular design that Silvia describes — "a database that was queryable with different graphical interfaces" — is for her the suitable configuration for managing different processes which are distributed at different points of the content's chain. Additionally, Silvia also sets out how the user of the tool is supposed to use it — "depending on where the content is located, the person who at that time must manage a task on the content enters, checks the status of the content, carries out his task and update it" — outlining, that way, what Madelein Akrich has defined as "script" (1992), namely a technical and social vision or prediction of sets of relations, uses, interactions inscribed in the design of the object, and in which the role of actants is played by both humans and non-humans.

Another interesting point about Silvia's vision of the tool concerns its main function as database. The hint at a "homemade" tool built by the previous coordinator of the team points precisely to the design and use of the artifact as digital storage. When I asked people in the team for further information about the tool, they explained that its domestic character depended upon the fact that it was built just for fulfilling the production team's needs, without involving other organization areas, as well as that it was not developed within an official project recognized by the organization. When the former coordinator left the team, indeed, the use of that tool ceased as well. As Ludovico — contents editor — puts it:

> The tool is a sort of database where we will store all the information related to contents been processed. Previously, we had a database that was created by our former coordinator, it was totally different, even graphically, less information, but it was effective. We have yet to experience the current tool because, at least on my part, I have been working very little with it. This is because it's a bit tough, in the sense that you have to stay on the platform and insert a number of parameters that are, yes, simple, but it is structured in a way that I don't like, that is, you need to do many steps, you have to change so many pages and there is little synthesis. (Ludovico, content editor, interview)

Here Ludovico remarks on the effectiveness of the previous tool as far as his specific tasks are concerned, namely getting to know what contents are to be processed and the deadline for the completion of the task. The requirement for the production team to introduce further information in order to standardize the whole process has engendered, according to Ludovico, some hindrances due to the thorny structure of the new database. In the next section I shall provide an example of the difficulties in finding coordination in the process of organizing contents.

5.3.4 "It's a lottery!": the tool as an artifact of standardization

As underlined in the previous section, the development of the tool revolves around the need to rationalize the whole process of working contents in Passic TV. The tool, indeed, is supposed to provide a standard form to organize information about contents so that they can be easily transmitted and used, thus ensuring awareness among individuals and different organization areas (Dourish & Bellotti, 1992; Dourish & Bly, 1992). Excel spreadsheets and email have been the main channels through which sharing information so far, systems that, according to the communities involved in the process, do not support the collaborative work smoothly.

The reasons why information awareness among groups often fails to be achieved can depend on a variety of circumstances: the program plan has changed but the content acquisition group forgets to inform other areas, an external unexpected event occurs and previous information change in a disorderly manner, information are conveyed in different forms. The latter occurrence has emerged during interviews with members of different groups:

> The publication group needs to know all the information about the movie, whether it is HD [high definition], full HD, SD [standard definition], or whether it has dual audio. At the moment we are writing this information in the naming of the movie, that is, if the movie is called 'John Doe', we put 'John Doe HD' if it is an HD, underscore "DA" if it has dual audio. So, by reading the naming, they [the publication group] understand if it is an SD, HD, if it has a dual audio. If there is not "DA", that means that there is no dual audio. (Ludovico, content editor, interview)

Here Ludovico provides a detailed example of the procedure the production team carries out in order to assign a name to the file containing the audiovisual content.

Although I do not have a visual representation of the “naming” described by Ludovico, it is very likely it looks like to something like this: “John Doe_HD_DA”. Such denomination seems to be quite clear for the production team, but it can not be as clear for another group:

> Do you want to see what I have to do to find a file out? I mean, in order to know if multimedia files are available, we use emails, which are these ones and get automatically to the inbox when they [the production team] upload the file: it’s Gysnant that automatically sends emails. Look, in order to search for something, I have to use the "search" function in the email, however, it may happen that the file is not uploaded with the same name of the program schedule. So, sometimes contents are in, but I do not know that, because maybe I've got the title in Italian, but it was uploaded with the English title and maybe it’s not even the complete title. It’s a lottery! It does not seem rational to me. (Laura, service development manager, interview)

Here Laura — who coordinates the operations of contents publication along with an automatic system called Gysnant — explains the difficulties she finds in detecting files. I read these words as an ideal continuation of Ludovico’s discourse about the job of contents processing. Once contents are encoded, indeed, the production area uploads them on Gysnant so that they can be put together with the editorial notes concocted by the publication group. If Ludovico describes the operation of putting a name to file as an apparently naïve operation, in the words of Laura such convention of practice (Bowker & Star, 2000) becomes problematic when the naming assigned by Ludovico and his colleagues does not coincide with the naming in the program schedule. By studying classification systems within nursing work, Bowker and Star (2000) claim that comparability (along with visibility and control) is the main area of challenge in crafting a standardized classification scheme within new information infrastructures. According

to the authors, comparability unveils a "strategy of moving toward universality: rendering things comparable, so that each actor may fit their allotted position in a standardized system and comparisons may be communicated across sites" (Bowker & Star, 2000, p. 241). In other words, the need for a standard description implies a shift from local and particular terminology and idiosyncrasies of each group to equivalents able to travel across settings.

The critical issue that Laura's words point out, then, is precisely such employment of different local terminologies — the contrast between the style of naming as described by Ludovico and the one in-scripted within the program schedule — which sometimes are too ambiguous to achieve an effective degree of comparability among groups, to the extent that to accomplish the task — finding the file out in this case — becomes a matter of chance and luck as winning the lottery.

5.3.5 Exploring further sociomaterial entanglements: the tool as an open-ended artifact

The early step of my research in Passic TV has revealed that the main function of the tool was that of being a large database wherein to store all the information about contents. Such vision is reliable at least for two fundamental reasons. In the first place, the current tool under development is built upon the previous design provided by the former coordinator of the production team, who developed a "homemade" artifact in order to fulfill this objective; secondly, although the tool is meant to be an artifact fostering coordination among different organization areas, its development comes as a specific demand of the production team, which uses it as database. However, being

the tool an artifact embedded in a larger information system, further potential uses were envisaged as Carlo's words betrayed:

> There are lots of things to take into account, because this tool eventually will have to manage information by connecting to two other systems used by Passic, which are the DAM, which is the tool that physically provides the content to the platform, and Gysnant, which is a data transfer system. Indeed, I believe it is conceivable later to integrate this tool directly into the DAM, which however both will change quite everything. That is to say, the database will likely stay the same, we will have to re-adapt the interface, because I do not know which kind of language and on what kind of platform the DAM runs, but I suppose that it's not a Web platform, so there will also be this thing. (Carlo, Web engineer, interview)

When I met Carlo he was at work to develop the main functions of the tool as database. Nevertheless, as he himself pointed out in the first interview, such job has not been a smooth process as new technical features and further organizational demands have inevitably affected the tool's development. Carlo's references to further employments of the artifact as part of a larger infrastructure are indeed taking place. After about one year since the project's outset, a larger group of software developers has taken over Carlo's duty as managers realized that the development of the tool implied further sociomaterial entanglements (Bjørn & Østerlund, 2014). Both production team's managers — Silvia and Bruno — I have worked with during my research have indeed confirmed the project's advancement:

> I was surprised, because I was very low profile at the beginning, I just wanted a tool to get by. But now it has become larger than what we expected and for this reason we are turning to a larger company for the development and then we will integrate it with other tools of Passic Network. It will no longer be a local tool, we have found the machines, we are putting it into operation, it has become something bigger than what we expected and this is also a good thing for both me and Leonardo. (Silvia, former production team's coordinator, interview)

Here Silvia speaks up about the unexpected expansion of the project of the tool. She remarks the fact that initially the artifact was designed to order and rationalize information, but later it has become larger than expected, to the point that one developer — Carlo — was not longer sufficient to accomplish the outcome. Actually, what I have realized over time is that there seems not to be a final outcome as the tool looks like an artifact without pre-determined boundaries (Bjørn & Østerlund, 2014).

In this regard, Pernille Bjørn and Carsten Østerlund (2014) speak of "open-ended artifacts" to point out that "the physical material form of the artifact does not create the boundaries, but instead includes/excludes various dynamic sociomaterial practices at particular times" (Bjørn & Østerlund, 2014, p. 92). By studying ethnographically the healthcare work in two emergency departments, Bjørn and Østerlund argue that it is possible to bridge the gap between the concept of 'sociomateriality' (an ontological approach) and that of 'design' (a practical concern) precisely by looking at how artifacts are enacted in different practices. Technical tools, indeed, are not stable entities, but rather dynamic ones, so that they bind together various sociomaterial practices while excluding other when they are enacted. According to the authors, the approach called sociomaterial-design fosters a shift from affordances and constraints of artifacts to the actual sociomaterial performances and intra-actions central to the process of organizing. Such an approach suggests, in the first place, to look at how practitioners bound multiple artifacts, locations and people's movements.

This argument is rather telling as to the tool's development in Passic TV insofar as it notes that the design of artifacts does not achieve a permanent closure, but rather it is involved in different and ever-changing processes of organizing. Such an

understanding of artifacts' life points also to the fact that multiple configurations of the same artifact can be enacted at the same time, depending on the intra-action wherein the artifact is involved. The tool as database, thus, does not represent a previous and old version of the new one, but it is enacted in the very practice, moment and location the tool is used as database.

At the end of my research in Passic TV, the service engineering team, and in particular Ludovico, has assigned a proper name to the tool, that is "content manager and publication assistant" (Content MAP). Such a name betrays his further employment, as explained by Bruno:

> It has been seen that this object begins to have information in its belly that can be very useful even for something that until some time ago we did not even dare to think of, such as, for example, the capacity to publish contents, which is something that today is done manually. This activity is done by a group of people which is outside of multimedia entertainment, they manage the publication of contents, so they create the content profile with the poster, synopsis, and price category. Now this whole thing, the population of a profile, is done manually. According to our road map, starting from next February, the Content MAP, the tool in the trivial name, will be able to automatically carry out the publication of contents, that is to build the profile by itself, without human intervention. (Bruno, content production e publication monitoring manager, interview)

According to Bruno, who took over Silvia's position as coordinator of the production team, the newly-named tool — Content MAP — is ready to carry out the task currently undertaken by humans within the customer care service. Bruno's reflection on the potential of the artifact, which is defined as something even unconceivable some time ago, is akin to the sense of surprise showed by Silvia. Along with being a large database, the Content MAP is supposed to take over the activities currently carried out by an entire group, that of publication.

5.4 Doing ethnography in Passic TV: challenges and dilemmas

In a paper eloquently titled "Ten lies of ethnography" (1993), Gary Alan Fine describes the moral dilemmas of field research. By laying out a trenchant argumentation, Fine claims that images of ethnographers are characterized by partial truths or self-deceptions related to virtues, technical skills and identity displayed while doing research. In claiming that behind any job there are operating procedures, assumptions about the world, compromises, Fine aims at reminding that research implies making choices — making cuts in Barad's words (2003) — and that, even though ethnography is ultimately about transformation, researchers should not take illusions for granted. As he puts it:

> Limits remain to what we do — obdurate limits — and we must not be blind to these limits: let us open our conceits to ourselves and our readers. A tension exists in my arguments: Am I suggesting that we produce *better* ethnography, or should we embrace out frailties? Do I provide advice or succor for inevitable failings (John Van Maanen, personal communication, 1992)? Like most cheery cons, I do both. As a psychoanalytic son, I believe in the maxim "know thyself" more than I believe in "better thyself". By knowing oneself, one can improve *a bit*, but more significantly, one can recognize that the limits of the art are part of the data. (Fine, 1993, p. 289, emphasis in the original)

What I would like to do in this section is to reflect upon what I consider the limits of my research in Passic TV. Like every scientific endeavor, limits are part of the process and they are helpful insofar as they become advices for future research. Aside from these considerations, in reflecting upon the potential shortcomings of my fieldwork, I have found myself agreeing with what Fine claims at the end of the above excerpt,

namely that analytical and empirical difficulties are issues to be developed rather than "imperfections" to hide.

5.4.1 On being a "guest"

As pointed out in *Chapter Three*, my research experience in Passic TV has been nowhere near neat and easy. The most pressing issue against which I struggled throughout the fieldwork was that of gaining and maintaining access. This issue refers essentially to two empirical circumstances: the multi-located character of the organization on the one end, and the low degree of acknowledgment of my research within the organization on the other end. Once I made my peace with the fact that I should not have physically been present in multiple locations at the same time, and having grappled with such problem through the literature about ethnography, the very issue affecting my research has been the little acknowledgement it has gotten, especially on the part of management. That meant, basically, that I had small margin for negotiating my presence and my work within the organization.

I can say that the many visits, interviews, informal conversations and direct observations I had over two years of research in Passic TV have rendered a problematized picture of organizational reality, which allowed me to delineate a quite careful description of the goings-on in the organization, and the main challenges affecting the process of organizing. The early observations of the meetings in which the production team took part have allowed me to grasp some perspicuous issues (e.g. the relationship between Passic Network and Passic TV, the need of a more efficient

coordination of the work practices etc.) that I could explore through interviews and observations. However, what I was not allowed to do was taking part to the actual practices through an internship within the organization. Indeed, although the whole chain of contents processing was rather clear to me after several months of visits, I realized I needed a more internal view on the processes in order to understand the actual ways by which people do what they say and account for what they *actually* do. My role in Passic TV throughout the fieldwork has indeed been that of a "guest", as the badge I was given each time I entered organization buildings ratified:

Figure 10. Badge

When I asked Dario to spend a period of work with the production team in order to conduct a prolonged participant observation, he actually made everything in his power to find an agreement with the head of human resources. Eventually, my request was not fulfilled due to bureaucratic and practical concerns as Dario explained to me. If at

first I thought this might have been a weak point in my research (and perhaps it is), it nevertheless gave me the chance to reflect precisely on the issue of power in doing research, which is what I shall do in the next section.

5.4.2 The importance of "studying up"

The never-ending process of renegotiating my presence in the field allows me to reflect upon the issue of power in doing research. As I have already explained, indeed, the many difficulties in gaining space for the research within the organization depended upon the fact that my research was never really supported by a large group of stakeholders, especially those organizational positions in higher hierarchies. The amount of field that I gained step by step was in fact the outcome of the efforts on my and Dario's part. Although I had the chance to speak with several people outside of the production team, we have never been able to reach higher positions, especially those within the engineering and technical areas.

All this suggested to me to question the perspectives through which the researcher constructs knowledge within the field. In this regard, I find particularly insightful the argument of the urgency of "studying up" advanced by American anthropologist Laura Nader (1972). Nader identifies three reasons for which researchers should engage with the study of powerful institutions and organizations. In the first place — she claims — concerns about the impact that large systems have on ordinary lives are energizing for many students. Studying insurance industry or the energy market or universities raises important questions about accountability, responsibility, ethics, which, according to Nader, constitute fresh motivations for

young researchers to carry out their work. Secondly, studying major corporations is necessary in order to re-establish scientific adequacy. As Nader notes, most anthropological studies take up issues raised by the poor, ethnic groups, people living and working at marginal positions, but there is little research on upper classes. If fieldwork is inevitably regulated by power relations, Nader claims then that it is important to ask how such relations affect theories we put forward. “Studying up”, rather than “studying down”, allows a sort of analytical reversion in asking, for example, “why rich people are rich?” rather than “why poor people are poor?”. Thirdly, Nader explains that “studying up” plays a service function towards citizen and democratic purposes.

Needless to say, the first obstacle to the study of powerful institutions that Nader mentions is that of access: “the powerful are out of reach on a number of different planes: they don’t want to be studied; it is dangerous to study the powerful; they are busy people; they are not all in one place, and so on” (Nader, 1972, p. 302). These arguments greatly resonate with my case. Many times, indeed, I was told that managers and senior engineers were busy, or not at work or not available. In a few circumstances, when I ask Dario to participate to important meetings, ethical concerns came up regarding the fact that I was not an “insider” (I was a “guest”, indeed), so that they preferred to keep strategic decisions and sensitive topics under secrecy.

Again, what I have learned from the many obstacles and objections I met during my fieldwork in Passic TV is that they are part of the data and they can also represent an input to rethinking the theoretical assumptions I have drawn upon in order to do field research

5.4.3 Ways of knowing: towards a feminist STS critique of organizations

Besides the investigation of the agency of non-human actors, the study of gender relations has been another issue that has informed my research in Passic TV. In this regard, I spent the early weeks of my field work in Passic TV paying a "diffuse attention" (Bruni, 2003; Bruni et al., 2005) to places, members of the organization, aesthetic aspects, technologies, rituals, thus trying to overcome the gender=women's equation typical of managerial studies and those approaches focused on diversity and equal opportunities between men and women in organization (Gherardi, 2003). As Gherardi (2003) explains, such discourses and policies tend to impose essentialist categories of difference or equity by focusing on single issues, be they women, men, technologies or macro-analyses of organization. Rather than focusing on single entities understood as empirical and stable subjects and objects, Gherardi suggests to turn the attention to the nets of sociotechnical processes, discourses, institutional arrangements which create forms of power backed by knowledge claims.

Following these considerations, I have found my other research interest — the analysis of non-human actors — and the feminist critique of science as fruitful inputs that have helped me to make such an analytical leap. In other words, the analysis of the development and the role of artifacts — such as the Tool — has allowed me to go beyond the discussion of gender relations as power differentials between men and women, in order to call into question precisely those sociotechnical arrangements that Gherardi (2003) recalls when she argues for a "tactical alliance" between organization theory and feminist theory. Such an approach resonates with an argument put forth by

Susan Leigh Star (Zachry, 2008), who claimed that feminist theory needs to go beyond the “good reparative work” in tracing the invisibility of women and other marginal groups in order to look more ecologically at the work that technical knowledge or a standard do. This recommendation animates the next chapter, in which I re-turn to the analysis of sociomaterial processes in Passic TV carried out through the lens of feminist technoscience studies.

6. KNOWING THROUGH FEMINIST STS: STORIES FROM THE FIELD

In this chapter I shall take up the issue of materiality concerning the process of organizing in Passic TV during my fieldwork. I shall discuss the role of non-human actors in the light of the analytic contributions developed by feminist STS. In this respect, the stories presented in this section confront the same matter addressed in the previous chapter but with different analytic sensibilities. The aim of the chapter is twofold: on the one hand, I shall illuminate the effects of the introduction of new digital tools in organization that have been neglected in the previous chapter; on the other hand, I thus emphasize the performative character of conceptual frameworks insofar as they are able to enact different and multiple realities (Mol, 1999; Law & Urry, 2004). Moreover, as Law and Urry (2004) argue, if social research enacts certain realities rather than others, then it should be take into account the realities it contributes to build up. This is, in fact, a matter of "ontological politics" insofar as it calls into question the political character of social methods.

These issues are fully and diversely take into account by feminist inquiry in science and technology. As we shall see in this chapter, using such methodological and analytic sensibilities to question the supposed neutral role of material artifacts help to unveil positions of silence, invisibility as well as the multiple tensions in which

materiality is entrenched. Troubling boundaries and binary divisions (sex/gender, masculine/feminine, nature/culture, hardware/software, science/technology) has been the fundamental aspiration of feminist critique since its inception. However, as Lucy Suchman claimed[41], such epistemological and political engagement does not result in taking one side (usually the weakest one) of such binaries; rather, it has to do more with dealing with tensions, multiplicity and ambiguity that ongoing entanglements of human and non-humans present. With the words of Donna Haraway (2010), such an engagement requires researchers to "stay with the trouble" rather than to disregard or to close it. In this chapter, I shall stick to this kind of engagement in order to interrogate the role of materiality and material artifacts in Passic TV.

6.1. Politics of knowing: thinking through feminism

In the introduction of a book titled *Transformations. Thinking Through Feminism* (2000), authors Sarah Ahmed, Jane Kilby, Celia Lury, Maureen McNeil, and Beverley Skeggs poignantly claim that "the desire for transformation animates feminist praxis" (p. 1). In tracing the multiple historical trajectories that feminist studies have marked, feminism is described as a transformative politics engaged with the question of how to intervene on traditional ways of knowing. As Marxist and Arendtian political thought indicates, the concept of 'praxis' suggests to bring together theoretical thinking and political action into the realm of everyday life and practices (Fotopoulou & O'Riordan, 2014). A similar concern is brought to the fore by queer studies — which have applied

[41] Here I am specifically thinking about a concluding remark Suchman drew at the end of the summer school in 'Feminist Technoscience Studies' held at Lancaster University in May 2016.

the concept of 'performativity' to gender (Butler, 1990; 2004) — as well as by interactionist tradition with the argument of "doing gender" (West & Zimmerman, 1987). By probing the relationship among feminism praxis, performances and practices, these analyses are all animated by a call for change. In asking how we can reflect on changes in the current moment, Ahmed et al. argue that wondering about transformation is a task of *thinking through feminism*.

The first instance of transformation within feminist agenda — and especially feminist studies of science and technology — keeps dwelling in the politics of knowledge (Gherardi, 2011). This issue brings about a twofold implication: the critical analysis of the ways by which knowledge is produced on the one hand, and the commitment to generating alternative practices of knowledge construction on the other. These concerns animate this chapter in which I wish to revisit some issues discussed in the previous chapter in the light of feminist hermeneutics (Lykke, 2010) so as to address what "thinking through feminism" might mean in empirical terms. In doing so, I shall be driven by an argument that Susan Leigh Star made in regard to the work to be done in feminist theory (Zachry, 2008), that is the need to go beyond the "good reparative work" in expounding the invisibility of women and other marginal groups, in order to look more ecologically at the work that technical knowledge or a standard do. According to Star, therefore, feminist theory should be employed in a more complex way because "it speaks to everything. Not just divisions and categorical bins, but rather a whole process of knowing" (Zachry, 2008, p. 449). Accordingly, the three stories from the field presented here address the overarching concern with the role that technical knowledge, materiality and technical artifacts play in reconfiguring

boundaries between human and non-human actors in the light of the recent debate on materiality and ontology in feminism and FTS (Barad, 2007; Alaimo & Hekman, 2008; Hekman, 2010; Dolphijn & van der Tuin, 2012). Each case presents a discussion about different processes whereby technical knowledge, materiality, digital artifacts and human actors are entangled and re-configured. Specifically, the first case addresses the struggles of a newcomer to fit in her new organizational area, which shed light on on the political implications of studying technology from the point of view of marginal positions (Star, 1991) and situated practice (Haraway, 1991; 1997; de la Bellacasa, 2012). The second case pertains to the role of materiality, specifically places, in defining division of labor and organizational life. Such issues are discussed in the light of the concept of 'sociomateriality' (Orlikowski 2007; 2010; Orlikowski & Scott, 2008) which is closely related to the materialist and ontological strand in feminist studies of science and technology. Finally, the third case examines the role of the Tool developed in Passic TV as a good example to "return" (Hughes & Lury, 2013) to the feminist-based concept of 'situatedness' in order to take into account the role of non-human actors in redefining the process of organizing as well as the multiple logics and tensions such reconfigurations entail.

6.2 “Where”, “what”, “who”: multiple membership and marginality in sociotechnical networks

During the first weekly meeting, Dario introduced me and my work to the team. We had an informal conversation just to get to know one other, they asked me some information about my research, I asked them general questions about their work.

> While I am talking to the people of the team, Silvia — the head of the team — enters the room and greets everyone. As happened earlier, Dario introduces me to Silvia and gives her general information about my research project. I ask Silvia about her job and for some initial information through which to start understanding the labor processes and the structure of the company. I come to know that she in an engineer and started working in Passic ten years ago; she has gone through several organizational transitions, the most significant of which is the current one, as head of the production platform. When I ask her to briefly describe the technological path of devices developed by the company, she tells that not all the ideas have brought about improvements, and that some projects have made some steps back rather than forward. She then recounts what they are trying to do at the moment, with a particular emphasis on the work of Leonardo, who is undertaking the development of an automatic system of encoding for contents, so that — Silvia explains — the guys will not handle that job manually anymore as it is now. (Fieldnote)

After this short conversation with Silvia, I have come to know some interesting information about herself and the company. She has a degree in engineering and she worked in different areas of the organization before coming to the production team. Although she is rather young (she is around 38-39 years old), her ten years of experience within Passic allow her to develop an informed view on the organization. Moreover, she emphasizes the work that she is undertaking, with the help of Leonardo, in order to automatize some of the processes they bring to bear to

“encode” contents, so that they can run on the many devices connected to Passic TV. The process of “automatic encoding” that Silvia, Leonardo and the engineering team are carrying on aims at making the technical infrastructure able to encode files, without human intervention. In illustrating such a “big shift”, as all of them seem to frame it, Silvia takes a scrap of paper and starts to sketch the functioning of technical systems — namely the tasks and relations among different tools at work (Star & Ruhleder, 1996; Star, 1999):

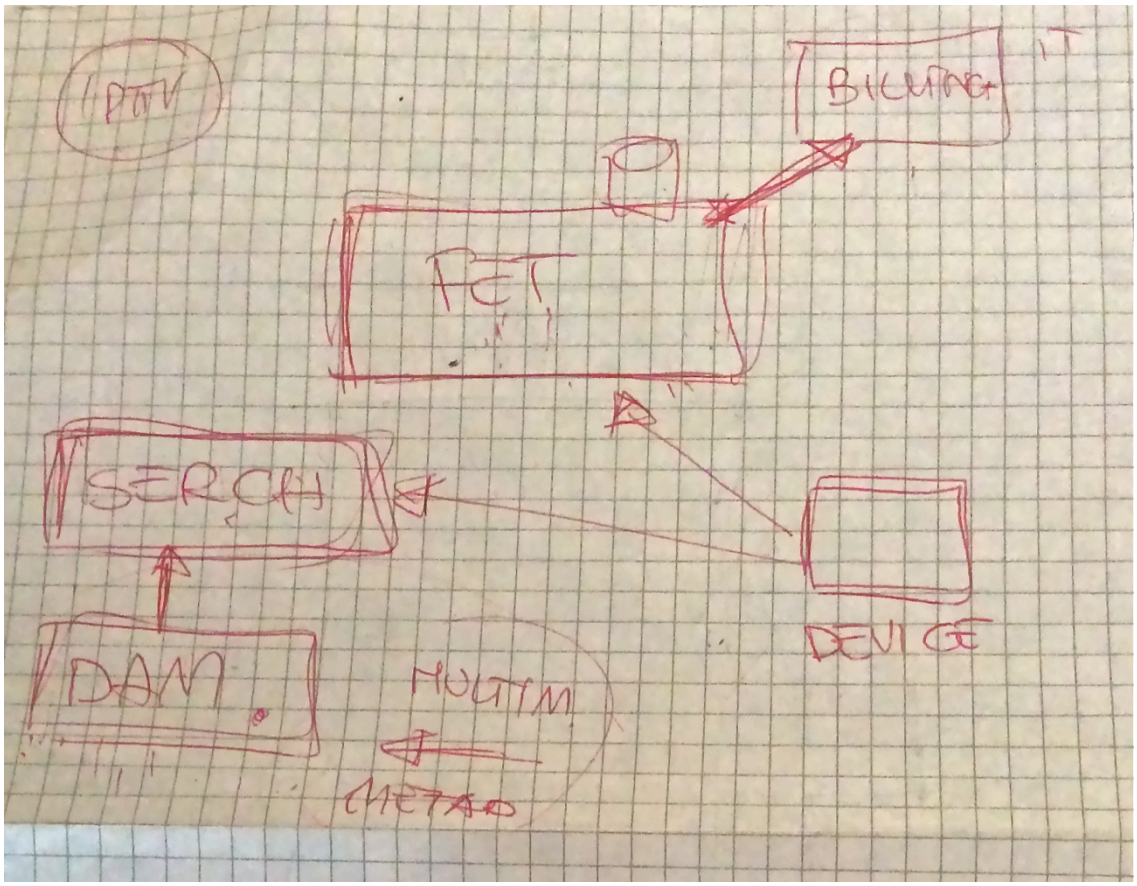

Figure 11. Sketch of the technical infrastructure

As I got to learn later on during the fieldwork, this sketch represents just a part of the whole technical system that supports contents processing and their release on the different devices. Rather, this visual representation became a matter of concern to me because, after that meeting, Viviana — who is the oldest member and the newcomer of the team — approached me asking if I could show her the sheet of paper wherein Silvia sketched the technical system. Intrigued by such request, I asked her about the reasons of such an interest. She answered that, as she was new to that group, she had not the chance to get a full picture of the organizational structure of Passic TV yet.

These first encounters with Silvia and Viviana gave me the opportunity to open up the question of power in social systems where technologies and technical knowledge play a great role. Following Star's discussion about the issue of power in the sociology of technology (1991), I have realized how my first interaction with Silvia and Viviana shed light on the crucial role of technology in "re-illuminating some of the oldest problems in social science" (Star, 1991, p. 33), specifically the problem of 'multiplicity' and 'multiple membership' within networks, and its relationship with marginality. Indeed, while Silvia provides a solid knowledge of the organization and its technical infrastructure, Viviana holds a marginal position in this regard insofar as she is a non-technical newcomer in a technical team, thus she seems unable to master the necessary technical and social knowledge in order to understand the sketch of the network drawn by Silvia. In sketching with competence and confidence the relations between technical platforms and organizational areas, Silvia showed to master conventions, practices, standards of that network, whereas Viviana appeared to be *as-*

yet non-member, thus the very same network that for Silvia is a source of confidence and benefits, for Viviana "it is a source of chaos and trouble" (Star, 1991, p. 42).

For these reasons, I decided to schedule an interview with Viviana shortly afterwards my first meeting with the production team. As a newcomer of the group, I thought it could have been a good idea to explore her peripheral participation (Lave & Wenger, 1991) to the production group, so as to understand her ways of learning and the difficulties she was encountering in such a process. During the interview, I have learned that Viviana was hired by Passic in 1993-1994 when she was 40 years old. She started working as telephone operator at the customer care of the company, when there was neither email nor digital supports to provide information to customers. Then, she changed and started working as secretary for some Passic's managers. After ten years of that job, she was asked to change again and to join the production team, a "totally unknown world" as she defined it. When I asked about the "sketch episode", Viviana told me about her difficulties to reach the center of the practice of the team she works in:

> you know, if we want to see it in more general terms, training should be done when a person starts a new job, especially if that person does not know anything about the new job. So, to begin with, it should be explained where she is and what people do there. […] I have never dealt with these aspects of the TV world. So, for me a 'wmv' or 'mpeg' file was Ostrogoth, I had no idea what they might be. (Viviana, project manager, interview)

This excerpt could be interpreted through the analytical perspectives familiar to organization studies as well as through those interdisciplinary approaches presented in the previous chapter. For example, the importance of training new and older

employees underlined by Viviana points to the critical issue of the variety of competences and expertise required by those organizations positioned in the so-called "knowledge economy". However, reading this response through different theoretical insights allows me to open up different questions (Mazzei, 2014). Viviana's lack of familiarity with the new job, indeed, refers to the fact that the new position requires technical knowledge that she does not hold. In this specific case, her manifested technical illiteracy — which she compares with an extinct language ("Ostrogoth") — undermines her agency, relegating her to the margins. Viviana's account resonates with what Star (1991) has defined as one of the great lessons of feminism, namely the "power of collective multiplicity". This has to do with the power of feminist critique to trace the experience of being *simultaneously* outsiders and insiders, rather than *either* in *or* out the network. The sense of strangeness with the TV world described by Viviana unveils her experience of marginality and resistance to being translated at the same time. Indeed, while the experience of enrolment in the new network and the encounter with the new standards is for Viviana a matter of concern and a source of anguish, her response does not reflect the extremes of being outside of or signing on the network, but it has "to do with a multiplicity of selves, partial signings-on, partial commitments" (Star, 1991, p. 50) as the following passage betrays:

> When I arrived I was told "ah there is a group of people that is in that building and work with contents that we receive from providers, which then are ready for the release". Ok. "You will see that there are these contents that are reworked through different formats…" and just this… "and the various formats are used on different devices". Ok. This is the story. I start my job and those who work on the release were like "I don't find the file for the pill, can you send it to me or may I find it out anywhere?". '*Pill*'? I have never heard of that, I have no idea what it is… to

> me ‘the pill’ is something to swallow. […] The problem for me was more to understand *what constitutes an issue* submitted to me, because I did not know what they were asking me and whom, in turn, I was supposed to ask about. Clearly the vocabulary is also important, because if I ask you something whose meaning you do not understand well, you don’t know where to search for it. That’s why it's important to know *where you are*, *what people do there*, *who is around* and what they do. (Viviana, project manager, interview, emphasis added)

This excerpt speaks to the poignant question Leigh Star raises when she criticizes the executive mode of power relations in ANT: “what is the nature of the personal in network theory?” (Star, 1991, p. 44). Indeed, the sense of loss that Viviana experiences when she confronts a new and local vocabulary (the “pill”) unfolds a “high tension zone” (Star, 1991, p. 47) that lies in the “impurity” of her multiple selves: a woman in her sixties, a former secretary coming from a traditional organizational culture, now a newcomer in a technical community of practice. The impurity of no longer being neither a secretary nor a fully competent member of the new team reveals all the uncertainties and tensions involved in processes of translation.

Here, again, feminist hermeneutics (Lykke, 2010) provide helpful analytical tools in order to raise diffractive questions. Indeed, the story of Silvia and Viviana, and their relationship with technical knowledge, sheds light on the political implications of studying technology from the point of view of marginal positions (Star, 1991) and situated practice (Haraway, 1991; 1997; de la Bellacasa, 2012). Such issues point to the importance of representing different point of views within a network as well as to the question of how to account for multiplicities and heterogeneities that occur in any network.

6.3. Repetitive work VS project work: enacting boundaries through spatiality

As often repeated so far, Passic TV is a multi-located company, which comprises offices in several Italian cities and in different geographical points in Rome. As far as my research has been concerned, I spent most of the time in the offices housing the production team (henceforth via Loriano[42]), with recurrent visits to the headquarters where management, marketing, communication, service engineering and content acquisition areas work (henceforth via Cischi). The two offices are located rather far apart from each other, at a distance of 13 km circa. They differ from each other in many respects, starting from their aesthetic appearance. Indeed, via Loriano presents a dreary narrow entrance, rife with turnstiles both inside and outside of buildings, with long and wide hallways which are often lit by artificial light sources; on the other hand, via Cischi's main entrance is large and brightly lit, encircled by long sidewalks decorated with trees and plants. The entrance hall is rather large, with a big desk where two operators use to welcome guests or withdraw mail for employee. Here is an excerpt from fieldnotes I wrote during my first day of ethnography in via Loriano:

> the building in via Loriano is very large, part of a larger whole. Even in this case it is a facility located at a bottom of a secondary street, not immediately visible from the main road. Unlike the place in via Cischi, the indoor environment appears bare, dark and sparsely populated: the impression is that the building is much larger compared to the number of people that actually contains. (Fieldnote, via Loriano, February 5, 2014)

[42] I use fictional names for reasons of confidentiality.

I took this note a few days after having visited for the first time Passic TV's headquarter in via Cischi, so the difference between the two locations looked quite striking to my eyes. As I came to learn afterwards during the fieldwork, via Loriano and via Cischi are not just two different offices of the same company, bur rather two places that matter for organizational life and for social analysis insofar as they *emplace* inequalities, identities, differences, power, politics, interactions, communities, memories, history (Gieryn, 2000).

Figure 12. Via Loriano, entrance

Figure 13. Via Cischi, entrance hall

As Thomas Gieryn claims (2000), indeed, while the issue of place has traditionally been an area of interest to geographers, architects, or environmental historians, sociologists have a great stake in this discussion as well. Following this reasoning, the analysis of place becomes an interesting issue to discuss also in relation to Passic TV within the feminist frame. Indeed, doing fieldwork in two different settings allows me to often come across with the critical relationship among places, work and organizational life that inform such differences. For example, I have noted that the coordinators of the production team I met in almost two years of research — Silvia and Bruno — work in Via Cischi despite the fact that the group is based in Via Loriano. Silvia and Bruno, indeed, came to visit via Loriano's offices on occasions, to communicate important information or to attend meetings. This was not the same for other managers and organizational areas (content acquisition, marketing, communication), which are entirely located in via Cischi. Another interesting fact I have noticed is that Dario, while part of the production team, used to work in via Cischi, trying to separate his work as much as possible from via Loriano. When I started the fieldwork, indeed, he started to collaborate with the communication area (located in via Cischi) and this job has become the main one for him along the time. At the moment, indeed, he is no longer part of the production group in via Loriano as he is working full time within the communication group in via Cischi. These preferences in terms of spaces have brought me to reflect upon the ways through which division of labor is *emplaced*, namely how it is constituted in part

through location, material form, and their imaginings (Appadurai 1996; Gieryn, 2000).

Against this backdrop, the concept of 'sociomateriality' (Orlikowski 2007; 2010; Orlikowski & Scott, 2008) emerges as a valuable analytical tool in order to detect the importance of materiality in the practice of organizing as well as to understand the discursive practices by which the material and the social become inherently inseparable. As American sociologist of organization Wanda Orlikowski has variously argued, while materiality is a vital aspect of organizational activity, it has either been disregarded or treated as an "exogenous force" though an "ontology of separateness" (Orlikowski, 2010). In response to these partial accounts of the relationship among technology, work, and organizations, Orlikowski advances that they are inherently inseparable by looking at a recent strand in STS and FTS that has specified such *relational ontology* (Introna, 2007; Suchman, 2007; Barad, 2003; 2007). Here, the concepts of 'intra-action' and 'entanglement' developed by Barad's feminist critique shed light on precisely the ontological primacy of relations — there are no independent objects with inherent boundaries, but rather material and discursive practices that enact certain phenomena.

A similar perspective appears rather insightful as far as boundaries and relations among space and work practices in Passic TV are concerned. As photographs and field notes have suggested, the difference between the space of via Cischi and that of Via Loriano lies in their aesthetic appearance in the first place. As Bruni explains (2003), the aesthetic dimension of organization is an

issue of increasing interest to sociologists and ethnographers. Bringing the focus on architecture and geography of places, interior furniture and decorations, objects, colors, light, smell is a crucial move to undertake in order to better understand the kind of work people perform in specific places, what kind of actors populate those places as well as power differentials among actors and organizational roles. Indeed, the difference in the outward appearance of via Cischi and via Loriano reveals different work practices and a different conception of work as Bruno's words point out:

> the distinction can be just trivial. Here [Via Cischi] I do the project work, at Loriano I do management work. This is to make a clumsy distinction, because, in reality, let's say that here [Via Cischi] there is the world of meetings more than anything else. This is the venue where all the meetings take place, because we, as production team, as Loriano world and publishing world, we are a cog in a big machine which is Passic TV; we discuss everything about Passic TV in these offices, that is to say anything concerning Passic TV's world and the engineering service is here. (Bruno, interview)

This excerpt is helpful insofar it brings to the fore interesting insights about the nature of spaces and the work carried out in the two different locations. In the first instance, Bruno marks a neat boundary between Via Cischi and Via Loriano as far as his work is concerned: Via Cischi is the place of project work, whereas via Loriano is the place where he does the management work, that is managing and coordinating the production team. Further on, Bruno claims that Via Cischi is the place where all the meetings take place and where all decisions are made, decisions that will inevitably affect the job carried out in other places. According to Bruno, therefore, the work carried out at Loriano is subordinate to the

decisions and choices made at Via Cischi, to the point that in his words they are understood and performed as different "worlds".

The relation of subordination and the material-discursive boundaries (Orlikowski & Scott, 2015; Barad, 2007) between the two spaces is enacted through the metaphor of the machine (Passic TV) and the cog (Loriano), where, in Bruno's view, the former is central whereas the latter is peripheral. This distinction is also telling as regards the division of labor performed through the practice of *emplacing*:

> Here, the world of Via Cischi and all the colleagues working in this area are all focused on project management, so there are two broad categories: a great division is between projects and operational work. Here people make projects, at Loriano they do operational work. That is to say, the difference lies in the fact that the operational work is the same every day, basically all days you do N activities and the next day you do those same N activities, in a cyclic way, continuously let's say. On the other hand, projects have a clear beginning and end, and, above all, they bring you an outcome that is every time unique, let me say. So whatever the project is, although it is similar to another one that you've already done, however it has some features that makes it unique. (Bruno, interview)

Here Bruno remarks the distinction between operational work and project management, the former carried out at via Loriano, the latter carried out at via Cischi. In his understanding, the difference between the two kinds of job lies in the boundary between the uniqueness that distinguishes a project to another one and the routinary character of operational work. The distinction between operational work and project work, between via Cischi and via Loriano, constitutes and actual material-discursive practice (Foucault, 1972; Barad, 2007),

namely a set of conditions of possibilities, relations and boundaries whereby to establish a certain order of things and knowledge, wherein, as Barad points out with quantum physics, matter — materiality, objects, bodies, apparatuses of measurements — comes to matter (Barad, 2003; Herkman, 2010, pp. 76-77). In this case, materiality manifests itself through spatiality, that is the material form of organizational places constructed with meanings and values, turnstiles and trees, specific understandings of labor division, and hierarchical relations.

As Gieryn points out, geographic location, material form, and investments of meanings and values cannot be unraveled or considered separately from one another since they are mutually shaping: places are, at once, buildings, furniture, streets, monuments, actors' interpretations, representations and identifications. These features emerge from Bruno's accounts of his works related to places insofar as a geographic location such as via Cischi — with its aesthetic dimension made up of open spaces, bright colors, the gym and the auditorium for corporate events and important business gatherings — is entangled with certain hierarchical roles (engineers, executives, management), thus with an idea of labor related to the development of projects and marked by "uniqueness"; by the same token, according to Bruno, the work done in via Loriano is characterized by repetition and implementation of decisions made in via Cischi. Such features are clearly ontologically related with specific material configurations made up of dreary places, control units, long and wide hallways, alarmed doors, and an abundance of grey.

Against this backdrop, the analytic perspective of 'sociomateriality' is closely related to the recent materialist and ontological strand in feminist studies of science and technology (Hekman, 2010; Dolphijn & van der Tuin, 2012) which has interestingly enriched such an understanding of the mutual implication of matter and meaning. Karen Barad has introduced the word 'entanglement' to describe such an inseparability:

> to be entangled is not simply to be intertwined with another, as in the joining of separate entities, but to lack an independent, self-contained existence. […] Time and space, like matter and meaning, come into existence, are iteratively reconfigured through each intra-action, thereby making it impossible to differentiate in any absolute sense between creation and renewal, beginning and returning, continuity and discontinuity, here and there, past and future. (Barad, 2007, p. ix)

It is precisely this inseparability of matter and meaning that inform the boundaries between operational work and project work, between via Cischi and via Loriano emerging from Dario's account. Indeed, such a distinction is discursively and materially performed as well as "iteratively reconfigured" through intra-actions of humans and space

6.4. The *Tool*: addressing the potential reconfigurations between humans and non-humans

As illustrated in the previous paragraph, a recent branch of research within feminist studies of science and technology is committed to rethinking and respecifying the intersections of humans actors and materiality (Hekman, 2010;

Dolphijn & van der Tuin, 2012); on the other hand, interdisciplinary fields at the crossroad of computer science, information science and science and technology studies — such as CSCW, HCI, and AI — are increasingly drawing on theories and approaches from feminist science and technology studies in order to reach more nuanced understandings of technological innovations and mediated collaborations behind contemporary phenomena such as in mobile development, big data, social media, and distributed practices (Bardzell & Bardzell, 2011; Steinhardt, Menking, Marshall, Zelenkauskaite, Erickson, Rode, 2015). Additionally, new academic experiences flourish with the aim of expanding the interdisciplinary and growing field of feminist science and technology studies (see Catalyst vol. 1, n. 1, 2015) and new media studies (Sawchuk & Stabile, 2012).

A pivotal challenge posed by feminist STS is that of developing different knowing practices able to rework the boundaries between human and non-human forces (Hughes & Lury, 2013). Christina Hughes and Celia Lury, for example, advance an ecological methodology in order to "*re*turn" the concept of 'situatedness' so as to take the non-human into account as much as the human. Their argument is worth mentioning for the analytical move they outline, that of 'returning'. Unlike the more popular "turns" in STS and social sciences (e.g., "ontological turn", "linguistic turn", "cultural turn", etc.), Hughes and Lury explain that "*re*turns" have to do with repetitions and coming back to persistent troublings, rather than new approaches to discover. As they put it:

> there is the intensity of multi-dimensional trajectories, as concepts are de- and re-contextualised. Within this intensity the long-standing feminist concerns with positionality, relationality and interdisciplinarity remain, with what can be known and who can be a knower, and with the centrality of ethical, transformative practices within relations of power, as well as a sometimes forgotten but nonetheless sustained acknowledgement that we live in, and are of, a more-and-other-than-human world. Such a re-turning allows us to re-think one of the most significant concepts in feminist epistemology, that of situated knowledge or situatedness in a way that takes account of how '"the human" is no less a subject of ongoing co-fabrication than any other sociomaterial assemblage' (Whatmore 2006, 603). (Hughes & Lury, 2013, p. 787).

The growing "intensity" that authors envision with respect to the concept of 'situatedness' is due to the fact that feminist critique of science and technology is increasingly engaging with the role of non-human actors, so that the analytical move of 'returning' advanced by the authors constitutes a helpful strategy in order to rework the concept of situatedness and take into account the role of non-human actors as well as the multiple and casual assemblages they are part of.

As discussed in the previous section with regard to spatiality, the suggestion to "return" to the boundaries enacted between humans and materiality has been rather insightful as far as the process of organizing is arranged in Passic TV. Here, I would like to continue such discussion by engaging the design and practices involving a digital artifact which I have unraveled in the previous chapter: the Tool. To examine its role in the light of feminist hermeneutics will help me to underline some interesting insights that otherwise would remain neglected. The analysis of a specific object (Latour, 2005; Bruni,

2005) and the ways it is embedded in a sociomateral infrastructure in fact allows me to think diffractively of the role of "missing masses" with respect to organizing.

The dynamic configurations and reconfigurations that the Content MAP may spark were couched at the beginning of my fieldwork (see the interview with Carlo in Chapter Five), but they have become evident along the time. During the last months of my research in Passic TV, I met Riccardo, an engineer and project manager at work within the content acquisition area. His job is at the interface between contents acquisition and publication; it supports technical processes behind publication of contents, which also comprise the design and development of new platforms for publication. When I talked to Riccardo, he told me about the main project he is working on, which is the development of the feature of recommendation. The feature is supposed to demarcate and predict viewers' preferences and, on these grounds, to recommend contents to the audiences. According to Riccardo, the development of this new feature constitutes a big project that, in his words, will generate "many impacts" on organizing, including potential connections with the tool and, accordingly, a broader reconfiguration between humans and automatic systems:

> We are evolving towards an approach in which many of the releases we do editorially will be made automatically, through this recommendation. Now I can not tell you how this thing [the recommendation feature] will affect the tool, we have not yet thought of it. In the first phase it might not have an impact on it, or maybe yes, because another way to present contents is through the so-called editorial collections; so, for instance, Disney Cinema is a collection, it is a logical grouping of contents that we need to show to

> the customer as a single set. At the moment, we define the collection editorially, namely we make editorial choices, we decide to release a certain content on the basis of our feels, how the wind blows or on what I see on the trade press; but tomorrow this collection might be managed by the recommendation engine console, so there are several elements that could have an impact on the tool. (Riccardo, multimedia content manager, interview)

This passage sheds light on a potential, but very likely, shift from a system of publication based on editorial work made up of human choices to an automatic system based on algorithms that would identify viewers' preferences and then make recommendations. Besides having a material consequence on Passic TV's interface (viewers will experience the recommendations feature after agreed on privacy policies), this new feature will also impact on the chain of contents processing insofar as the program schedule will be constructed automatically to a great extent. The sense of becoming emerging from Riccardo's words is quite enlightening as far as the boundaries between the human and the non-human are concerned.

This state of "in-between-ness" where multiple forms are viewed at the same time is an interesting issue developed by feminist materialism and post-colonial studies. Perhaps the most popular work in this regard is *Borderlands/La Frontera: The New Mestiza* (1987) by Gloria E. Anzaldúa. This book revolves around the idea of crossing borders, "La Frontera" between the U.S. and Mexico in the first place. According to Anzaldúa, borders are clear lines that define places, divide "here" from "there", that distinguish Latinos from Americans, subjects from objects. On the other hand, a borderland is a liminal space, still

undetermined as its boundaries are unnatural. A borderland, therefore, is a land of tensions, ambivalence and transition, the territory of multiplicity and becoming. Reading Riccardo's words through the lens provided by Anzaldúa's reflections on borders is particularly intriguing insofar as it sheds light on the processes of co-invention that include both the human and the non-human which are entangled through dynamic and multiple relations (Hughes & Lury, 2013). The above excerpt, indeed, unveils precisely a condition of undetermination ("I can not tell you how this thing will affect the tool […] in the first phase might not have an impact on it, or maybe yes"), in which the agency of human actors ("we have not yet thought of it […] we make editorial choices, we decide to release a certain content on the basis of our feels") intra-acts with that of non-human actors ("but tomorrow this collection might be managed by the recommendation engine console"). The latter has increasingly emerged along the conversation with Riccardo:

> One thing is clear, that this tool is an anticipation of what one day will be a tool embedded within a new DAM, that is within a publishing platform, which really splits the activities which belong… well, more than split, *it changes the weights of the activities* that today are distributed over two groups. […] We are just thinking about it, indeed, and a group, the publication group, which today is slavishly copying and pasting editorial information on the movie sheet, will likely change activities and will be moved to other activities as you increasingly automate the work. (Riccardo, multimedia content manager, interview)

Here Riccardo illustrates how the improvement of technical infrastructure is supposed to change the process of organizing, emphasizing a growing leading role of automatic tools which, in his words, will "change the weights of the

activities that today are distributed over two groups". Such changing trajectory is further explained in another passage:

> So, think that, right now, there are about ten people who work for publishing; perhaps these people start to become overabundant if the vast majority of the information is uploaded automatically. The tool is suited to gather these information and then download them to the DAM, as much as it is suited to gather information about publications dates, while metadata that I've described before is something that is always stuck to the content. The fact that I want to broadcast contents from January 1 to December 31, and from June 1 to December 31 is an editorial choice. Today this piece of information, along with all the others, is always added by the publication group; in the future, the tool can download them to the DAM, as well as download all the metadata since it holds these information. (Riccardo, multimedia content manager, interview)

Here Riccardo points to the potential functions of the tool, which, according to his view, are supposed to take over a great amount of human work. As also Bruno have remarked in the previous chapter, engineers and technical staff have realized that the tool holds a great amount of information in its belly, so that it can also take over editorial choices such as when to publish a certain content, an information that, at the moment, is managed by the publication group.

These ongoing processes of intersection of different layers of the sociomaterial infrastructure (the new recommendation feature that can, or cannot, have an impact on the tool; the tool that is conceived of as a database, but later it becomes more that that, to the point that it could take over the entire process of publication) reflect in many respects the idea of 'configuration' developed by Lucy Suchman (2012) since such processes emerge as "constitutive and generative, reiterative and (potentially) transformative material-semiotic

conjoinings" (Suchman 2012, p. 57). As with the idea of 'borderland' suggested by Anzaldúa, the trope of 'configuration' that Suchman discusses is informed by Haraway's argument of "materialized refiguration" (Haraway, 1997, p. 23) and is concerned with how humans and machines figured together — "configured" — through technical discourses and practices, and how they can be configured differently (Suchman, 2012, p. 49). Configuration, therefore, is at the same time a method to think about sociomaterial assemblages and the object under scrutiny insofar as it constitutes the effect of how matter and meaning are configured.

The impact of the tool on the whole technical infrastructure governing contents processing in Passic TV as described by Riccardo allows me to return on Hughes and Lury's initial quote about rethinking the concept of situatedness in light of the agency of non-human actors. Indeed the sense of becoming concerning the tool emerging from Riccardo's words — "We are *evolving* towards an approach in which many of the releases we do editorially will be made automatically…", "One thing is clear, that this tool is an *anticipation* of what one day will be a tool embedded within a new DAM […] it *changes* the weights of the activities", "in the *future*, the tool can download them to the DAM, as well as download all the metadata since it holds these information" — elucidates precisely the shift from a social to an ecological epistemology in which non-human actors play a great and somewhat unpredictable role in re-configuring practices of organizing and "weights" that necessarily involve technical and non-technical knowledge, division of labor, and power differentials.

For example, the publication group “which today is slavishly copying and pasting editorial information on the movie sheet” as Riccardo says might be moved to other duties with the increasing automation of the process. The potential and actual relations configured by Riccardo constitute a sociomaterial assemblage that brings things together, “fixing them through reiteration but also always engaged in ‘the perpetuity of coming to be’ that characterizes the biographies of objects as well as subjects” (Suchman 2012, p. 50). I add here a visualization of such arrangement:

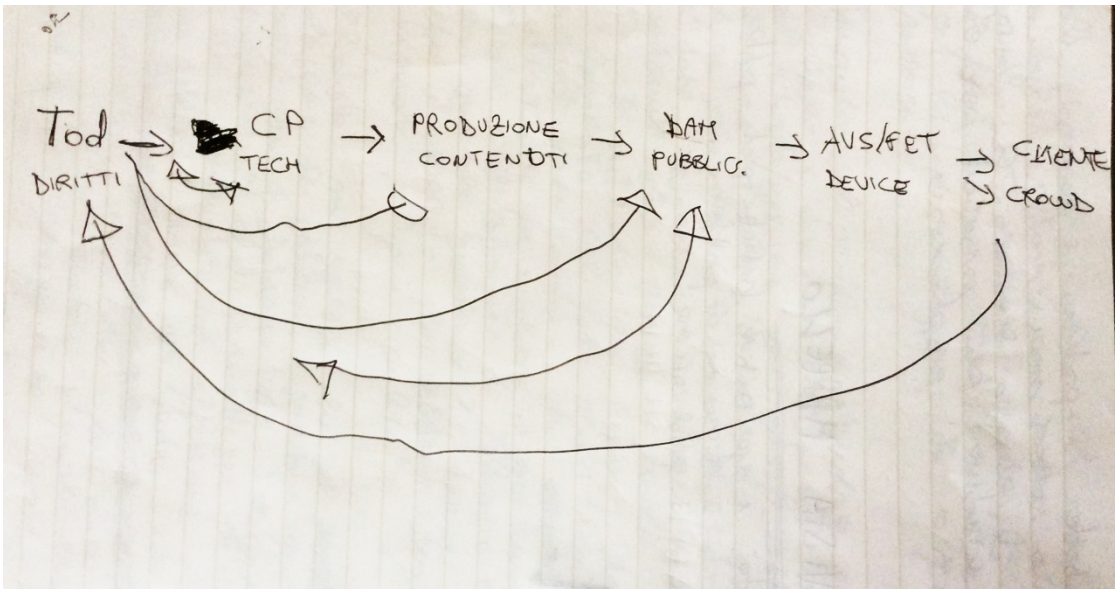

Figure 14. The Tool within the sociotechnical infrastructure

This sketch was drawn by Leonardo (the technical operator who is engineering the tool and gave it the name of ‘Content MAP’) when I asked him to illustrate how the tool is configured within Passic TV’s technical infrastructure. In drawing this rather rough representation, Leonardo explained to me that the

implementation of the tool is having many implications for the whole organizing as even Riccardo said. As the sketch shows, the tool is of course linked to the platform of content acquisition (CP Tech) as well as to the DAM, which is the platform through which contents are published. Moreover, as database, the tool also contains all the information regarding contents rights ("diritti") which determine how long an audiovisual can be online and on what devices.

If we compare this visual cue with the content processing chain, we see that the tool would take over the duties that at the moment are still managed by two organizational areas: the production team and the publication team as even Riccardo said. The development of the tool, therefore, is sparking a reconfiguration between human makers/users and material agencies. At the moment the tool appears an incomplete project — a borderland — as the multiple logics and tensions it conveys are undergone continuing reconfigurations. It would be interesting to observe how multiplicities and contradictions, typical of any complex information system, will be managed, and boundaries enacted. As for the re-thinking of situadeness by taking into account the agency of things and objects as Hughes and Lury suggest (2013), the story of the development of the tool in Passic TV shows the value of an ecological gaze insofar as it unfolds a mode of investigation that considers "the potential — of what might be as well as what is — in any situation or relations of situatedness" (Hughes & Lury, 2013, p. 797).

7. CONCLUDING REMARKS

7.1 Feminist understanding of information technology: nodal points and multiple settings

This dissertation has taken shape from the overarching research interest in studying Information Technology with the lens of feminist studies of technoscience. I have addressed such subject matter through the engagement with two different empirical settings: a set of semi-structured interviews with female professionals committed to promoting more women and gender awareness in IT fields and an ethnographic study within a telecommunication company.

The link between the "desk" and the "field" (Czarniawska, 2014; Strathern, 1999) has been characterized by a process of mutual shaping, so that overarching epistemological and theoretical issues have been unraveled in the messy world of phenomena, and, conversely, the engagement with actors and practical circumstances in the field has served as a respecification (Garfinkel, 1991) of theoretical underpinnings.

Against this backdrop, in *Chapter One* and *Chapter Two* I have illustrated the theoretical frames, analytic sensibilities, keywords, and research questions that have animated this study. The analysis has been carried out in the light of feminist studies of science and technology, a rich body of work that, following Lykke (2010; 2011), can be regarded as a set of "nodal points", namely a discursive site that has historically gathered a plurality of epistemological and political traditions rather than fixed definitions. The articulation of such debate in connection to computing and IT represents a first contribution that this dissertation provides insofar as feminist critique of computing is still a relatively young subject in comparison to other traditional disciplines such as mathematics, biology or physics. Therefore, it becomes crucial to nurture the nascent feminist research on computing as some studies have already demonstrated (Adam, 2000; Misa, 2010; Abbate, 2012). Such debate stems from the various angles whereby feminist theories have performed the analysis of technology (Wajcman, 2000; 2010) and computing (Balka & Smith, 2000). If on the one hand liberal approaches have addressed the shortage of women in computing in order to orient the choices of policy-makers (Margolis & Fisher, 2002; Balka & Smith, 2000; She Figures, 2015), a more nuanced feminist critique of computer technologies has problematized the construction of knowledge (Adam, 2000; Adam & Richardson, 2001; Björkman, 2005; Harrison, Sengers, & Tatar, 2011; Muller, 2011; Rode, 2011) in computing science as well as practices of design and modes of thinking with machines (Edwards, 1990; Green et al., 2003; Suchman, 2007) on the other.

Following such analytic sensibilities and interdisciplinary theoretical references, in *Chapter Three* I have explicated the methodological choices I have made in order to attend the research questions that orient this study. Additionally, I have described in more detail the two empirical cases I was involved with for almost two years. In this respect, I have drawn on a diverse set of methodological tools such as ethnography, semi-structured interviews, historical analysis and statistical data which have been useful to account for the plurality of issues raising from two different empirical settings and the multiple links they present with the interdisciplinary theoretical background. Accordingly I have juxtaposed such a "methodological bricolage" with the practice of "poaching" (de Certeau, 1984; Czarniawska, 2004), meaning that I have borrowed some methodological tools from different fields (ethnography from anthropology, historical analysis from history of technology) and re-contextualized them for the purposes of this research. Indeed, the presence of two different settings and the interdisciplinary scholarship I have drawn upon to engage with them have required the employment of multiple methods in order to render the heterogeneous character of the issues under scrutiny (Silverman, 2006)

The employment of feminist hermeneutics as "nodal points" as well as the engagement with two empirical sites has also brought me to grapple with methodological concerns. These have to do with the multiplicity and diversity of methods in feminist studies (Lykke, 2010), which, in turn, derive from the multiple epistemologies that inform feminist research. As Lykke (2010) points

out, different epistemological approaches have different implications in terms of methodology and method. In this study, the recourse to different methods — such as statistical data, historical analysis, ethnography and interviews — has served as heuristic tools to accomplish two goals: to examine discourses and practices around information technology and to reflect upon the generative character of such modes of knowing. In this respect, my engagement with two different field sites has unfolded the importance of employing different analytic devices in order to problematize what, at first glance, appear as self-explanatory demands on the one hand, and to make visible what is apparently invisible on the other.

More specifically, in the first field site, which have comprised some statistical data about the presence of women in IT educational and professional paths as well as interviews with female engineers, managers, software developers and students involved in campaigns and networks that aims at empowering women in IT, I have problematized claims and demands in terms of gender power relations and equal opportunities by calling into question the relationship between women and computer technologies. In the other field site, which presents an ethnographic study within an Italian telecommunication company, I have sought to trace some issues pinpointed by feminist approaches in science and technology — such as how to enact silence (Star & Bowker, 2007), give voice and representation to the traditionally invisible (Star, 1995), interrogate boundaries (Suchman, 2007), highlight local and marginal positions (Haraway, 1988; Braidotti, 1994) — by questioning the material infrastructure

that support and enable the cooperative work in a tech company. In doing so, I have tried to bring feminist STS sensibilities into workplace studies, emphasizing the performative character of conceptual frameworks insofar as they are able to enact different and multiple realities (Mol, 1999; Law & Urry, 2004).

Against this backdrop, in the following paragraphs I will discuss in more detail the main findings I have traced out from such intersection of conceptual nodal points and empirical research in multiple settings.

7.2 Women confront computing

In order to investigate IT as professional and technical culture in the light of FTS, I have started from the analysis of the most visible phenomenon, namely the gender gap and shortage of women in computing and computer science, which is presented in *Chapter Four*. The examination of data is anything but a trivial issue as figures and numbers are essential for identifying problems and indications of policies (She Figures, 2003). Such line of inquiry aligns with those analyses that, according to the literature (Balka & Smith, 2000; Faulkner, 2001; Cozza, 2008; Wacjman, 1991; 2000; 2010), underscore women discrimination and segregation along their careers, sexual divisions in the labor market, differences in human capital and domestic responsibilities between men and women. Starting from these considerations, I have moved beyond those processes that keep women outside of computing in order to question the relationship between female practitioners and computer technologies as well as the ways women

problematize gender issues in their technical field. In doing so, I have drawn on those perspectives that, in rephrasing Harding (1986) shift from "women question in science" to "science question in feminism", have raised the "technology question in feminism" (Faulkner, 2001) in order to problematize the very processes by which technology is designed according to gender assumptions.

Following this line of inquiry, I have carried out a historical analysis that revolves around the development of computing as a professional field, underlining both the contribution of women as proto-software developers and the gendered material-semiotic practices that shaped the division of labor and technical knowledge in the nascent digital computing. The analysis of the experience of the female American professionals at work on the first digital computer machine in the 1940s-1950s brought me to shift the analytical focus to contemporary female professionals and practitioners in IT industry, specifically those who are openly challenging the gender status quo in computing by participating to campaigns and networks that foster more female presence and gender awareness in educational and professional paths.

The recourse to a proximal view (Cooper & Law, 1995; Giancola & Viteritti, 2014) through interviews and direct observations has enabled an understanding of the issues raised by these networks that goes beyond the claim, yet necessary, of "more women in tech". The analysis, indeed, has brought to the fore the ambivalence which women experience in encounters with technology (Pinch & Trocco, 2002; Corneliussen, 2005; Abbate, 2012; SSL Nagbot, 2016) and even in

their participation to such initiatives. With regard to the latter, for example, some women who joined my research have openly criticized those campaigns that point to the "pink aspect" of technology in order to attract young female students. According to some IT professionals, these modes of framing interventions tend to reproduce stereotypes about gender and technology, so that technology is trivialized in order to attract women. On the contrary, the stories I have collected reveal that, in entering technical fields, women were motivated by a strong passion for technical subjects and safer opportunities of employment. These arguments are quite at odds with those rhetoric that aim at recruiting women in IT by outlining a supposed model of femininity the sees women as more inclined to communication and social skills.

On the other hand, if certain stereotypical gendered frames of computer technologies are matter of concern among some women, the very same respondents outline differences between men and women in approaching computer technologies. These differences pertain to emotional, cognitive and practical dispositions toward technology and technical knowledge. An issue emerging from interviews, for example, is the argument by which women are "more intuitive" than men in approaching the solution of mathematical problems. According to Zelda, this is a "typical feminine characteristic", that is not an "essentialist projection of gender" (Schiebinger, 2001, p. 6), but rather as *another* way to approach the subject. The question of difference is also invoked to outline a practical approach to technologies performed differently by men and women. According to this viewpoint, women would be more interested in the

functional and social implications of technologies, whereas men would be more attracted to technology per se, regardless of their potential usages. Such a discursive practice seems to unfold an understanding of sexual differences in relation to technology, by which there would be a *female style* to deal with technical artifacts which is different from a male one. However, such natural differences are not posed to claim a disadvantage of women in relation to men, but rather to emphasize what is *another*, yet equally worthy, way to deal with technologies.

If computer technologies and technical knowledge related to IT call into question the construction of gender structure and gender identity (Harding, 1986) as discussed so far, interviews with female software developers, engineers and computer science scholars have also pointed up the gendered characters of technologies and IT artifacts (Faulkner, 2001; Green et al., 2003). Such findings refer to the potential gender biases inscribed into the design of technologies and to symbolic and ideological associations between gender and computer technologies. The interviews with Maria and Eva are significant in this regard as the point to the gendered character of IT artifacts as Wikipedia and user interfaces. This criticism calls into question the techniques of the design process and the gender-scripts (Rommes, 2000; Oudshoorn, Rudinow Saetnan, & Lie, 2002; Oudshoorn, Rommes, & Stienstra, 2004) incorporated into technological artifacts. According to Madeleine Akrich (1992), the term “script” or “scenario” refers to the vision or prediction about the world which is transferred into the technical content of objects. Accordingly, inscriptions embody set of relations

between humans and non-humans, forms of knowledge, modes of ordering the world and even moral judgment. They assign and delegate competencies, actions and responsibilities to potential users, thus defining who the users of the technology will and can be (Rommes, 2000;). In this respect, 'gender-scripts' refer to assumptions and representations of gender relations and gender identities inscribed in content and form of technological artifacts. The study of gender inscriptions has revealed, how technologies invite or inhibit specific uses by men and women due to the gendered user-representations they convey (Oudshoorn, Rudinow Saetnan, & Lie, 2002). The "male character" and lack of user-friendliness of Wikipedia underlined by Maria as well as the "testosteronic interface" of GNOME denounced by Eva point precisely to a specific user-representation in terms of gender relations and identities that, in their opinion, would inhibit women's participation and use.

The analysis of discourses and practices of female practitioners and professional around IT technologies has therefore shed new light on the issues that feminist critique of science and technology has long discussed. A similar analysis — which aims at problematizing IT as professional and technical culture from women's standpoint rather than focusing on processes of female segregation from technical fields — allow us to challenge those arguments that point to women's fear and reticence toward machines (Turkle, 1988) by showing powerful forms of reflexivity and agency that female IT professionals bring to bear.

7.3 Questioning materiality in organization

The advantage of regarding the theoretical frames of this study — STS and FTS — as sets of nodal points, as Lykke (2011) suggests, lies in the possibility to gather the plurality of epistemological and political traditions that such bodies of knowledge advance in order to address the main research questions and empirical findings developed in this study.

In *Chapter Four* I have discussed the gender gap and shortage of women in computing and computer science by means of historical analysis and interviews with female professionals in IT who openly challenge the gender blindness which renders information technology as a neutral artifact; in *Chapter Five* and *Chapter Six* I have employed STS, workplace studies and FTS to question materiality, more specifically the material infrastructure that support and enable the cooperative work in an Italian telecommunication company called Passic TV.

The reason why I have treated the analysis of the same field site with different, though overlapping, conceptual toolboxes — STS and workplace studies in *Chapter Five,* FTS in *Chapter Six* — lies in two lines of inquiry: to trace out the agential role of material artifacts in the process of organizing on the one hand, and to discuss the agential character of theories on the other. In doing so, I aimed at showing how the analysis of materiality undertaken with traditional STS scholarship and with FTS poses different concerns, thus enacting multiple and different realities (Mol, 1999; Law & Urry, 2004; Barad, 2003). For example, if STS and workplace studies have come to problematize the very boundaries between the social and the technical (Latour, 2005; Heath & Button, 2002), they have little

to say about the ethical and political consequences of such realignments. Such concerns are instead openly taken into account by feminist technoscience studies when they address how to enact silence (Star & Bowker, 2007), give voice and representation to the traditionally invisible (Star, 1995), interrogate boundaries (Suchman, 2007), highlight local and marginal positions (Haraway, 1988; Braidotti, 1994) in the analysis of technology. However, as Star (1991) and Haraway (1997; 1988) argue, examining technoscientific phenomena from the point of view of those who hold marginal positions is not just politically significant, but also analytically interesting insofar as it reveals multiplicities, layers of silence and invisibility, forms of violence and marginality that otherwise would not have been tracked down. In this respect, in *Chapter Five* I have pointed out the analytical fruitfulness of focusing the analysis on a digital artifact, the tool, since its design and implementation reveal problems of coordination and collaboration among organizational areas; in *Chapter Six* I have used FTS to take up the investigation of a similar issue concerning technical knowledge by presenting the stories of Silvia and Viviana. This case brings up the issue of power in the sociology of technology (Star, 1991) as the experiences of Viviana — a woman in her sixties, a former secretary coming from a traditional organizational culture, and a newcomer in a technical community of practice — and Silvia — a young engineer with ten years of experience Passic TV and a growing career — unfold the role of technical knowledge in generating central and marginal positions within organization. More in detail, the conceptual tools provided by the feminist critique of technoscience are crucial to identify the

problem of ‘multiplicity’ and ‘multiple membership’ within networks, and its relationship with marginality (Star, 1991).

By the same token, the concept of ‘sociomateriality’, which has been developed in the field of organization studies (Orlikowski 2007; 2010; Orlikowski & Scott, 2008), has deeply drawn on recent contributions from materialist and ontological thinking in feminist studies of science and technology (Barad, 2003; Barad, 2007; Hekman, 2010; Dolphijn & van der Tuin, 2012). Such a conceptual device does not merely point to the agency of non-human actors as, for example, early analyses in Actor-Network Theory (Callon, 1984; Law, 1987; Latour, 1993) has pointed out. Rather, the concept of ‘sociomateriality’ advances an inherent inseparability among humans, non-humans, discourses and theory, thus arguing for a *relational ontology* (Introna, 2007; Suchman, 2007; Barad, 2003; 2007). The conceptual leap here lies in the ontological primacy of relations as the concepts of ‘intra-action’ and ‘entanglement’ developed by Karen Barad explain. This means that there are no independent objects with inherent boundaries, but rather material and discursive practices that enact certain phenomena.

Such inseparability of matter and meaning inform the division between operational work and project work that rules the processes of organizing in Passic TV as well as the tensions and contradictions that the development of the tool entails. In their discursive and material performances as well as iterative reconfigurations, the entanglements of matter and meaning (Barad, 2007) points to the value of adopting an ecological gaze (Hughes & Lury, 2013) as it unfolds a mode of investigation that focus on the potential of what might be as well as

what it is, the space of tensions and becoming rather than that of stable and fixed entities.

In undertaking such analysis, I have sought to take up Star's recommendation (Zachry, 2008) to employ feminist thinking not just to examine women's experience and power asymmetries between men and women (as I have also done in the first field), but to look more ecologically at the role of technical knowledge and non-human actors within the process of organizing. Accordingly, I have turned the attention to the nets of technical, material, human and more-than-human processes (Alaimo & Hekman, 2008; Hughes & Lury, 2013) in order to understand the ontology and agency of the material world in generating marginality, centrality, visibility and invisibility.

7.4 Situated knowledge and partial connections

The juxtaposition of STS with FTS in examining gender troubles in IT and the role of technical artifacts and materiality in organization has thus served as a fruitful case to discuss the politics of knowledge pursued by feminist scholarship (Gherardi, 2011). Such a concern attends to both the critical analysis of the ways by which knowledge is produced and the commitment to generating alternative practices of knowledge construction on the other. This is all the more true for the same very studies, like this one, which advance these arguments. Therefore, as this dissertation has shown, my engagement with analysis of IT as professional and technical culture, besides and because of being situated in multiple empirical

settings, has been partial in the sense claimed by Donna Haraway (1988) and Marylin Strathern (2005). This means that it has been at once incomplete and committed. As Haraway points out, all visions are embodied, thus they produce partial, locatable and critical knowledges. In the case of this research, producing situated knowledge has meant, for example, to frame the analysis of IT as professional and technical culture within STS and FTS. Such analytic sensibilities have by all means oriented my inquiries and empirical research through the assumption that technical knowledge and artifacts are themselves constructed and performed within local practices and communities (Gherardi 2006; 2001); and yet such assumptions have been unraveled and respecified by means of certain methodological tools — historical analysis, interviews, ethnography, statistical data — that have enabled a proximal vision (Cooper & Law, 1995; Giancola & Viteritti, 2014) rather than a distal one. Additionally, attending to situated knowledge, in this case, means to recognize the fact that this dissertation is situated in an Italian PhD program and is the outcome of a research carried out in Italy, yet it is written in English. This means that these pages inevitably select certain audiences and readers — an international academic readership and, simply, those who understand English — while they exclude others. While such remarks may sound as analytical and methodological flaws, I instead offer them as interpretative keys through which this study should be taken into account. Indeed, the arguments of "partial perspectives" (Haraway, 1988) and "partial connections" (Strathern, 2005) argue that the condition to

make objective inquiries and rational knowledge claims rest on epistemologies of location and positioning.

The argument of partiality of knowing practices is somewhat reworked by Karen Barad when she points to the performative and ontological character of knowledge making:

> We do not uncover preexisting facts about independently existing things as they exist frozen in time like little statues positioned in the world. Rather, we learn about phenomena-about specific material configurations of the world's becoming. The point is not simply to put the observer or knower back in the world (as if the world were a container and we needed merely to acknowledge our situatedness in it) but to understand and take account of the fact that we too are part of the world's differential becoming. And furthermore, the point is not merely that knowledge practices have material consequences but that *practices of knowing are specific material engagements that participate in (re)configuring the world*. Which practices we enact matter — in both senses of the word. Making knowledge is not simply about making facts but about making worlds, or rather, it is about making specific worldly configurations — not in the sense of making them up ex nihilo, or out of language, beliefs, or ideas, but in the sense of materially engaging as part of the world in giving it specific material form. (Barad, 2007, pp. 90-91, emphasis in the original)

Following this line of thought, I have discussed the constitutive practices of knowledge making that sustain this dissertation. In doing so, I was driven by the powerful dictum — "it could have been otherwise" — claimed by sociologists Everett Hughes (1970) and Susan Leigh Star (1991) in the attempt to outline fruitful openings for further research and future enactments.

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