Chapter 2
Understanding the Research and Academic Field of STS

Abstract By analyzing and investigating AmI and the IoT as science-based technologies in the context of the European society, this book is positioned within the research and academic field of STS. With its two broad streams of scholarship consisting of (1) research on the nature and practices of S&T and (2) on the risks and other negative implications of S&T, STS is concerned with the study of the complex, dialectic interplay between scientific and technological developments and innovations and other dimensions of social life, treating S&T as cultural productions and historical events. In light of this, it involves distinctive assumptions, aims, methodological designs, analytical concepts, perspectives, and objectives. The intent of this short chapter is to provide insights into key underpinnings, methodological and analytical aspects, multi- and inter-disciplinary perspectives, and educational goals pertaining to the research and academic field of STS. This chapter is structured as follows. Section 2.1 covers key STS's emphases, aims, and premises. Section 2.2 provides an account on the contribution of Michel Foucault and Thomas Kuhn to the field of STS. Section 2.3 elucidates STS's methodological and analytical orientations. Section 2.4 introduces the multiple disciplinary perspectives associated with the research field of STS and the primary aim of espousing such perspectives. Section 2.5 gives a descriptive account on the interdisciplinary approach, focusing on the rationale behind its use in current research as well as characterizing aspects. This chapter ends, in Sect. 2.6, with a brief discussion on some educational facets and goals of STS.

2.1 Key Emphases, Aims, and Premises of STS

As a relatively new academic and blossoming interdisciplinary research field, STS (also referred to as science and technology studies) concerns itself with the relationship between scientific knowledge, technological systems, and the wider

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socio-cultural system in which such knowledge and systems are embedded. In other words, it deals with how social, cultural, and political conditions shape scientific research and technological innovation, and how these, in turn, constitute society, culture, and politics. Conceptualizing S&T as cultural and historical constructions, this field of research seeks to uncover how scientific discovery, knowledge, and authority operate within different social contexts, as well as to understand their perennially changing historical conditions and meanings. STS emerged and became institutionalized about four decades ago, following numerous controversies and polemics among and between experts and other strategic and societal actors over the role of science-based technology and innovation in society. It brings together many leading scholars (e.g. historians, sociologists of science, philosophers, etc.) from a cross-section of disciplines, who analyze such issues as the creation, construction, emergence, evolution, reception, uptake, practice, dissemination, role, contribution, and impact of various forms of S&T and their advances in modern society. That is to say, STS scholars investigate and analyze the ways in which S&T materialize and unfold, and why and how they become socially anchored, institutionalized, and interwoven with politics and policymaking; moreover, they study the social, political, psychological, ethical, and environmental effects of S&T, and attempt to provide a philosophical analysis and evaluation of the ramifications pertaining to such effects. In view of that, S&T are analyzed as socio-cultural and material practices that are shaped or engineered by the society and represent a crucial basis for social and political action and thus the (re)production of social and political reality. In this regard, they are approached as a set of interrelated social institutions holding distinctive arrangements, practices, discourses, commitments, and allegiances that are specific to various cultures at different times of history. Also, S&T are associated with risks and other implications for science-based technology is narrowly perceived—mainly by its originators or creators—to evolve independently of society, having a subsequent impact on societal transformation, once it gets released in and reach society—societal dissemination. In the context of this study, notable tensions between scientific knowledge and technological systems and their unintended adverse consequences, which produce controversies (pertaining to ethical and human values, environmental sustainability, social sustainability, and democracy), encompass how scientific knowledge is used in European politics and policymaking in relation to AmI and the IoT technologies; the manners in which such science-based technologies give rise to disagreements related to the natural environment, individual and social wellbeing, cultural and ethical values; and the role of science-based (ICT) innovations in environmental conflicts.

The two main premises of STS are: (1) that the ways we understand, view, construct, and explain the world are subject to constant reconfigurations, perennially changing, as they are historically and socio-culturally specific and contingent, and (2) that our knowledge of the world is not mere reflections of reality or pure representations of nature, and thus should not be treated as absolute or objective truths. One implication of this is that scientific discoveries and technological

developments will continuously be situated in a volatile and tense relationship with an inherently contingent, heterogeneous, fractured, conflictual, plural, and reflexive social world.

2.2 Michel Foucault and Thomas Kuhn's Contribution to STS

The two notable products of the interest of many historians, sociologists of science, and philosophers of science in the relationship between scientific knowledge and related applications and society were Thomas Kuhn's (1962) study, *The Structure of Scientific Revolutions*, and Foucault's (1966, 1969) two studies, *The Order of Things: An Archaeology of the Human Sciences and The Archaeology of Knowledge*. Both Kuhn and Foucault adhere to the aforementioned premises shared by social constructionist approaches (see next chapter for a descriptive account on social constructionism). Their influential works were instrumental in crystallizing a new approach to social and historical studies of science, in which scientific knowledge and related facts and claims were seen as outcomes of socio-culturally and historically conditioned inquiries rather than as pure representations of nature or mere reflections of reality. Foucault challenged the validity of the absolute truth claims pertaining to the human sciences, contending that they are articulated within the limits or confines of a particular (scientific) discourse and society's general politics or regimes of truth (see next chapter for clarification). Foucault (1972) assets that knowledge, whether theoretical or silently invested in practice, is fundamentally culturally-contextual and historically-situated, and a matter of episteme, the rigid understandings of truth that lies beneath all the discourses of knowledge of a particular epoch, which is a subset of historical a priori—'positive unconscious of knowledge'. This implies that different periods of history constitute different epistemological fields or systems of thoughts, and all social constructions of (scientific) knowledge fall under the episteme of a historical epoch. Similarly, Kuhn (1962) challenged the then prevalent view of science as a buildup of objective facts towards a more understanding of truth, contending that scientific discoveries are contingent upon the kinds of questions scientists ask, which in turn hinge on their philosophical commitments, among others. One corollary of this is that the prevailing scientific assumptions and premises used to probe or look at the world become riddled with issues, which can incite radical scientific revolutions. These are dubbed by Kuhn as paradigm shifts (see next chapter for a detailed definition). Paradigm shifts alter the behavioral patterns underlying the evolution of knowledge by changing how scientists view the world in terms of the way they go about to reason about nature, i.e. the questions they formulate about the world as well as the instruments they employ to understand it. This relates to the concept of episteme dubbed by Foucault in the sense of the conditions of possibility for knowledge. In particular, the distinguishing characteristic of modern science is its methodology—the means and tools by which it achieves results and accumulates knowledge about

the world around us. This knowledge cannot be infallible merely because there is no definitive truth, and the quest for it will continue ceaselessly. Besides, human experience and reasoning remain limited to fully comprehend and transcend what is larger than us and contain us—the world. The only truth discovered so far is that there is no absolute truth. Science does not currently—and probably never will—give statements of eternal truth, a timeless form of it. It only provides theories, which should properly be evaluated as beginnings rather than ends. Some of these theories will indeed be refined or expanded and others may even be completely discarded in favor of alternative theories that might emerge in light of new data generated by scientists. In all, scientific knowledge is in constant change. This implies that, as Kuhn (1962) concluded, the path of science through paradigm shifts or scientific discoveries is not necessarily (and perhaps won't be) toward truth but merely away from previous mistakes or errors.

Foucault and Kuhn's works have forced scholars within the human sciences and science, respectively, to reflect on the assumptions that underpin their empirical endeavors, to seriously consider matters of epistemology—e.g. epistemological limits. The implications posed by their theories have been at the center of a plethora of explorations, e.g. dedicated books, by high-profile scholars and theorists, writing about, often highlighting, their contribution to the human sciences and science. Their aforementioned books have given rise to ongoing disagreements over the specificity and contingency of scientific knowledge and the nature of science and what this entail in terms of the availability of truth as well as the possibility of evolutionary progress. Philosophers and sociologists of science posit that the shifts in knowledge configuration, from episteme to episteme or a paradigm to paradigm ought not to be conceptualized as a sort of evolutionary progress towards better system of thought and thus knowledge—manifesting a history of its growing perfections, but rather a mere pragmatic understanding, what is socially and historically valued and considered to be knowledge.

Foucault is considered by many as one intellectual icon of the postmodern pantheon and Kuhn as a prophet of postmodernism—who both regarded truth in its various formulations and configurations as social and historical constructs built on the view of a society at a specific point in history. Their works are seen as an examination of the scientific community and society at large. Among the several ramifications of their work was a systematic endeavor by sociologists of science and social scientists to investigate how scientific discovery and technology (Kuhn's focus) and scientific knowledge and its discourses (Foucault's focus) link up with other developments in society pertaining to culture, politics, policy, ethics, institutions, jurisprudence, and so on. In the context of this book, it is postulated that science-based technologies (and techno-discourses) develop dependently of society, in a mutual process where they both are shaped at the same time and thus affect each other and evolve. In other words, science and technology are socially situated and mediated: advances in S&T shape and influence society and vice versa.

2.3 Methodological and Analytical Orientations

Seeking to provide an inclusive analytic outcome addressing pertinent problems and issues at the interface of STS and thus achieve a broad understanding of socio-technological phenomena, STS adopts a multi-perspectival approach to the study of sociotechnical imaginaries, the imagination of social futures or worlds based on science-based technologies. This is accomplished through an interdisciplinary perspective, which supports analyses whose approaches are drawn from or informed by a variety of disciplinary perspectives. The approaches suited to the study of sociotechnical imaginaries are the interpretive inquiry and analytical methods that illuminate the relationship between technological systems, political culture, institutional and organizational behaviors, and policy designs as structures, on the one hand, and the subjective, socio-psychological, and historical dimensions of agency pertaining to multiple actors involved in the practice of research, innovation, and technology development and its societal dissemination, on the other hand. Thus, methodological frameworks in STS emphasize scientific, socio-cultural, philosophical, and historical perspectives on the interface between science-based technology and society. Among the qualitative approaches employed in STS, separately or in combination, include discourse analysis, comparative historical analysis, deconstruction, ethnography, cases and controversies, and so on. It is to note that most qualitative research methodologies adopted for the analysis of sociotechnical imaginaries can be employed in STS research in manners that are adapted or attuned to the ways in which such imaginaries function—that is, used in distinctive ways to explore their emergence, construction, evolution, uptake, institutionalization, and, eventually, cultural dissemination. Further to the point, the underlying assumption of the methodological integration is that the strength and soundness of arguments about science-based technologies in society, or sociotechnical imaginaries, depend on creative and synergic juxtaposition of evidence from a range of sources, using multiple approaches—multi-perspectival work. Besides, as STS engages complex issues in the emergence of science-based technological systems, a variety of methodological approaches are needed to capture both emerging issues of techno-scientific enterprises (or modernist science and technology projects) as well as historical trends.

The analytical focus of STS depends on the nature of the topic under investigation—e.g. science-based technology. In the context of this book, the focus is on historical (a priori), epistemic, discursive, material, institutional, and political aspects in terms of the analysis of AmI and the IoT technologies in the European information society; the social analysis of the European culture of ICT innovation; and the ethical, democratic, and environmental reflection on scientific and technological innovations pertaining to AmI and the IoT. As sociotechnical imaginaries, the AmI and the IoT visions have a genealogy as well as links to analytical concepts.

2.4 Multi-disciplinary Perspectives

As a necessity to understand the complex issue of scientific and technological innovations that science and technology are not the only driving forces of the modern, technologically advanced or high-tech society, as well as to respond knowledgeably, critically, reflectively, and holistically to the most pressing issues and significant challenges of the modern world, STS takes, espouses in scholarly research, an interdisciplinary approach. Accordingly, it approaches science-based technologies from a variety of disciplinary perspectives, including history (of scientific knowledge), sociology (of scientific knowledge), philosophy of science, cultural studies, political science, innovation studies, economics, technology foresight studies, sociotechnical studies, science and innovation policy, environmental and energy studies, and so on. This is to allow exploring in rich and compelling ways the interrelated worlds of scientists, technologists, politicians, policymakers, and citizens with reference to science-based technologies by examining the social, political, and historical conditions of their construction, emergence, evolution, uptake, and dissemination.

2.5 Interdisciplinary Approach—Justification and Characterization

STS is an interdisciplinary research field. Accordingly, related scholarly research operates out of the understanding that advances in knowledge and an ever-increasing awareness of the complexity of emerging phenomena have led scholars or researchers to pursue multifaceted problems that cannot be resolved from the vantage point of a single discipline. AmI and the IoT are problems that are inherently too complex and dynamic to be addressed by a single discipline, thereby the need for an interdisciplinary field as an organizational unit and, thus, the relevance of an interdisciplinary approach to the study of the topic on focus. Especially, the current study is not concerned with any impact on theory building or theoretical development for coping with the changing and evolving human condition, in which interdisciplinary endeavors remain limited and inadequate. AmI and the IoT represent fields of tension between social, cultural, and political practices and the development and performance of technological systems. With that in mind, some research topics remain within the framework of disciplinary research, and others, which are usually situated across disciplinary boundaries, can't be accomplished in disciplinary research. Espousing an interdisciplinary approach in this (STS) scholarly research made it possible to flexibly respond to the topic under inquiry in its complexity and variety and, thus, uncover the best way of addressing it. This approach is aimed at contributing to an integral reflection upon where the still-emerging fields of AmI and the IoT are coming from and where they are believed they should be heading.

Seeking to provide a holistic understanding of the AmI and the IoT phenomena for the common purpose of policy or in the pursuit of other common tasks, interdisciplinary approach insists on the mixing of disciplines. Thereby, it crosses boundaries between disciplines to create new perspectives and insights based on interactional knowledge beyond these disciplines. It is of crucial importance because it allows interlinking different analyses and spilling over disciplinary boundaries. The fields of AmI and the IoT should see the surge of interdisciplinary research on the incidence of technological, social, cultural, political, ethical, and environmental issues. Interdisciplinary research can also provide insights into rethinking AmI and the IoT as technological innovations, with the capacity to create methods for informing technology and innovation policies and to propose approaches to conceiving of technology innovation in its social context. Pooling various perspectives and modifying them so to become better suited to AmI and the IoT as advances in STS is therefore very important in order to arrive at a satisfactory form of multidisciplinary AmI and the IoT. The subjects of AmI and the IoT appear interestingly differently when examined from different disciplinary perspectives and integrated with them.

2.6 STS in Higher Education

The rise of STS in higher education is a response to an ever-growing need for preparing students as future professionals to be effective and competent in understanding how the world operates and how its significant challenges should be tackled, and through this understanding take actions that support societal development in a more strategic and sustainable fashion. In view of that, STS promotes critical, reflective, and holistic thinking; integrated values-driven approaches; interdisciplinary cooperation or cross-disciplinary integration; and civic engagement. This entails that the focus in higher education should be on broad and inclusive knowledge rather than on highly specialized skills with narrowly focused knowledge. STS enables students to acquire a great deal of knowledge given its inherent multidisciplinary and interdisciplinary orientation, unlike other academic approaches that emphasize the in-depth or exhaustive study of highly-focused topics. In fact, cross-field knowledge is increasingly becoming crucial to understanding and exploring multifaceted problems and complex phenomena. Conversely, it has been widely recognized that specialization in research institutes and higher education institutions does not fully prepare, educate and train, pre-professional students as key constituents of society to respond holistically, critically, reflectively, and knowledgeably to the most pressing issues and significant challenges of the modern world. STS aims to bring together the two philosophies of human and social sciences and natural and formal sciences. And by both building bridges between disciplines that don't ordinally converge due to their focus in terms of specialized or generalized knowledge as well as providing ways of integrating knowledge in areas that are extremely difficult to comprehend through

any single discipline, STS broadens and fortifies students' thinking and reasoning when examining, characterizing, and tacking complex problems. And it enables them to form more robust understandings of the nature of debates over the risks and other negative implications associated with all forms of advances in S&T, the grounds and drives of scientific and technological innovations, and the interplay between culture and its pre-cognitive or intellectual space of knowledge and how it affects rational analytic approaches to characterizing and explaining multifaceted problems. This is predicated on the assumption that configurations in such space are grounded on a set of claims, postulations, conjectures, premises, values, and truths basic to how the whole culture decides and justifies what is certain of—which is determined to be perennially changing or susceptible to constant reconfiguration.

For those who are interested in gaining a deeper understanding of the field of STS, there are numerous sources that provide comprehensive overviews or detailed accounts on the topic. Notable of these sources include, and are not limited to: Biagioli (1999), Bijker et al. (1987), Jasanoff et al. (1995) and Sismondo (2003).

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