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## 4 Science and Technology Studies Approaches to Internet Governance: Controversies and Infrastructures as Internet Politics

Francesca Musiani

Research seeking to bridge Internet governance research with approaches in science and technology studies (STS) began growing in the second decade of the 2000s. Complementary to predominantly institutional approaches that set the agenda for Internet governance research in its early days—and are still prominently featured in it—STS approaches consider the agency of technology designers, policy makers, and users as they interact, in a distributed fashion, with technologies, rules, and regulations, leading to consequences with systemic effects that may, at times, be unintended. Social and political ordering is understood as a set of ongoing and contested processes—an ensemble of mundane practices that contribute to maintaining, hacking, circumventing, developing, testing, or using the Internet. Thus, conceptually, STS-informed Internet governance research relies on understanding governance as a normative system of systems, and it acknowledges the agency, often discreet yet pervasive, of both human and nonhuman actors and infrastructures. This chapter provides an overview of the current ways in which STS approaches are being applied to Internet governance research, and in particular, it focuses on controversy studies and infrastructure studies as two subsets of conceptual and methodological tools that are gaining increasing traction.

The chapter opens by retracing how STS first approached the Internet as a subject of study and examining how some key concepts in STS have found their way into Internet studies. It then proceeds to discuss the key aspects of applying an STS-informed analytical and empirical framework to Internet governance research, including assemblages and hybrid arrangements as means of “ordering” in Internet governance and the structural and performative effects of controversies on norm-making and decision-making.

In its second part, the chapter addresses more closely how STS-informed approaches to Internet governance analyze the structuring and performative

effects of controversies on governance. It considers how controversies around claims of doing Internet governance (Epstein, Katzenbach, and Musiani 2016), made by different actors or groups, contribute to the creation of different worlds in which specific notions of governance make sense. The chapter will discuss how the study of controversies unpacks governance as a theoretical and operational concept by exposing the plurality of notions it refers to and their potential conflicts (Cheniti 2009a; Ziewitz and Pentzold 2014).

Finally, the chapter discusses how STS approaches to Internet governance focus on the agency of nonhuman actors and infrastructures as loci of governance mediation, such as information intermediaries, critical Internet resources, Internet exchange points, and surveillance and security devices (Musiani et al. 2016). The chapter will address how Internet governance takes shape through a myriad of technical architectures and infrastructures, “control points” (DeNardis 2014, 11) that are often discreet and invisible yet nevertheless crucial in building the increasingly public and articulate network of networks.

The chapter concludes by assessing the applicability of the STS lens to the study of Internet governance and its intersections with other approaches to Internet governance studies.

### **STS Meet Internet Studies: Introducing *Dispositifs* and Boundary Objects in the Study of the Internet**

As Sandra Braman highlights in chapter 2, it may now be almost an academic given that the Internet is socio-technical in nature; however, it is often useful to recall this, as it reminds us that all processes carried out on and by means of the Internet have both a technical and a human component—including governance approaches. Indeed, as seminal articles such as DiMaggio et al.’s (2001) at the turn of the millennium have made explicit, the Internet as a research subject has “social implications” that make its analysis thoroughly relevant for social scientists.

Approaches issued from STS are among the tools that social science researchers have mobilized to investigate the complex nexus of Internet and society. Janet Abbate notes that

STS can be useful to address the complex links between Internet technology and culture, which have blurred the frontiers of traditional categories. One of STS’ tenets is to “open the black box” of technology to understand its functioning,

and understand how social relations and aims translate into artifacts. STS similarly offer models to describe how human and non-human actors exert joint agency in mediated environments. (2012, 170)

The STS turn in research addressing information and communication technologies is founded in the sociology of innovation's interest in technical objects and in social practices of appropriation of emerging technologies, in media sociology's increasing interest in information and communication technologies, and in the development of information and communication sciences: information and communication technologies become "interactional artifacts" (de Fornel 1994, 126). With the advent of the Internet, an object-centered, interdisciplinary field of study follows at the end of the 1990s, with the creation of Internet studies. The "STS turn" within this field calls for a particular attention paid to context and situated practices, the unveiling of the invisible work of Internet innovation, to paraphrase Susan Leigh Star (1999). STS approaches put emphasis on the practices that shape the management and governance of the Internet and its uses as a living reality, and they determine the ways in which it operates, works, resists, and functions. Furthermore, STS approaches invite consideration of values and rationalities of Internet and web practitioners not as *indicators* of how they perceive the world but as *resources and categories* that they deploy in specific circumstances in order to create and uphold specific configurations—in short, to actively organize their world (Cheniti 2009a).

STS have helped recognize technical artifacts' status as mediators inasmuch as they can modify the performativity of social actions. In this conception, it makes less sense to consider discourses and objects as separate spheres and more sense to understand discourses as circulating within objects, both spheres coconstructing each other (Gillespie, Boczkowski, and Foot 2014).

The notion of *dispositif* (in the Foucauldian sense, often translated as "device" in English) and boundary object are among the notable concepts at the intersection of Internet studies and STS. A socio-technical *dispositif* is defined as an assemblage of human and nonhuman actors, whose competencies and performances are distributed and whose existence is enabled by the workings of innovation. Moreover, the notion allows integration of agency (Proulx 2009) in the analysis for a more fine-grained appreciation of its collective dimension. With the concept of boundary object, Susan Leigh Star and James Griesemer (1989) have sought to analytically describe those processes in which actors coming from different social worlds, and called

on to cooperate, manage to coordinate despite their diverging points of view. Because they account for the processes of delegation of work or other activities, or for the performative action of artifacts in the production of knowledge, boundary objects allow us to conceptualize the work of coordination, alignment, alliance, and translation among the different actors and the worlds they mobilize (Trompette and Vinck 2010).

These notions—which are both concepts and practical methodological tools—have been recognized as useful, alongside approaches in political science, international law, and economics, for tackling the macro questions of politics and power related to Internet governance by unpacking the micro practices of governance as mechanisms of distributed, semiformal, or reflexive coordination (Hofmann, Katzenbach, and Gollatz 2016), private ordering (Elkin-Koren 2012), and use of Internet resources.

### STS Meet Internet Governance

Devices and boundary objects are just two among the concepts and tools that STS scholars have developed to study social order, an “effect generated by heterogeneous means” (Law 1992, 382), making the actual, continuous *processes* of ordering—of economic, political, discursive, technical, or other nature—the main focus of scientific inquiry. In this context, governance is understood as a set of dynamics of social ordering, which does not happen exclusively (and, possibly, not primarily) in politically designed institutions but is also enacted through mundane practices of people engaged in maintaining or challenging the social order (Flyverbom 2016; Woolgar and Neyland 2013). This approach to the study of social order implies new ways to question and reassemble what we think of as both the *Internet* and *governance*. Indeed, this sensibility for social order as continuous and contested processes translates into a growing attention to the mundane practices of all those involved in providing and maintaining, hacking and undermining, developing and testing, or simply using the network of networks (Musiani 2015), thus expanding the notion of governance in Internet governance.<sup>1</sup> These diverse practices are seen not as mere objects of regulation but as elements constitutive to articulating, reifying, and challenging established, emerging, or contested norms—it is the “doing” of Internet governance (Epstein, Katzenbach, and Musiani 2016).

It is also argued that an STS lens relieves the pressure of pursuing a single precise definition or perimeter of Internet governance as a mandatory

prerequisite to any meaningful enquiry (Ziewitz and Pentzold 2014). Instead, STS approaches mostly consider the assumptions deriving from this operation as deterring the understanding of how Internet governance is enacted, in pervasive, networked, and often invisible ways.

Conceptually, STS-informed Internet governance research relies on understanding it as a normative system of systems, and it acknowledges the agency, often discreet and pervasive, of both human and nonhuman actors and infrastructures. Empirically, STS-informed Internet governance research focuses on the dynamics of ordering of assemblages and hybrid arrangements of Internet governance; on the structural and performative effects of controversies and destabilizations on norm making and decision-making or on the construction of authority and trust; and finally, on hybrid forums, private arrangements, and users and their practices. All these components help flesh out the doing of Internet governance and may be of use in revisiting central, yet ill-defined, concepts such as multistakeholderism. Epstein, Katzenbach, and Musiani (2016) unpack those key aspects, a discussion that I reprise and expand on here.

First, STS approaches acknowledge that technical and political governance are becoming increasingly intertwined. Scholars of Internet governance, and not only from STS, acknowledge more and more broadly the plurality of these modes of governance (two notable examples in this book are chapter 2 by Braman and chapter 6 by Hall and her coauthors); the next step is to incorporate their inability to be fully separated. STS approaches plead for an understanding of Internet governance as coexistence of different types of norms, elaborated in a variety of partially juxtaposed forums, and enforced, implemented, or merely suggested via a plurality of normative systems: law, technology, markets, discourses, and practices (Brousseau, Marzouki, and Méadel 2012). In chapter 10, Ten Oever and colleagues provide a useful overview of the mosaic that constitutes this multiplicity of normative sources and rightly point out that some normative features that had not been technically built into the Internet in its early days (because, of course, several of its spectacular developments could not be foreseen) subsequently had to be retroengineered in the network of networks or compensated for by other normative sources.

Acknowledging these diverse origins of norms relevant for the use and design of the Internet, most STS-informed Internet governance researchers base their understanding of governance in ordering instead of regulation,

management, or control (Elkin-Koren 2012; Flyverbom 2011). According to them, the concept of ordering not only captures the normative effect of mundane practices and daily routines; it is also considered particularly well suited to the analysis of the organizational forms of global politics not as static entities but as assemblages—hybrid configurations constantly reshaping their purposes and procedures so as to connect and mobilize objects, subjects, and other elements around particular issues. In this light, the very institutions of Internet governance can also be explored with an STS-informed toolbox, as Mikkel Flyverbom (2011) has done for the United Nations, seeking to capture the complexity of global political governance arrangements as embedded practices.

An important feature of STS approaches is the investigation of nonhuman actors and infrastructures as loci of mediation. Indeed, information intermediaries, critical Internet resources, Internet exchange points, and surveillance and security devices play a crucial governance role alongside political, national and supranational institutions, and civil society organizations (Musiani et al. 2016). Internet governance takes shape through a myriad of infrastructures, devices, data fluxes and technical architectures that are often in the backstage, yet crucial in building the increasingly public and articulate network of networks. Laura DeNardis (2014, 11) defines these entities as infrastructural “control points,” around which are entangled matters of technical and economic efficiency, as well as negotiations over human and societal values such as intellectual property rights, privacy, security, transparency.

Scholarly and policy discussions on “governing algorithms” and accountability of algorithms connect with this aspect and explore the governing power of algorithms (Mager 2012; Ziewitz 2016) as they predict and personalize users’ behavior on the Internet and the perception other actors (institutions, firms) have of them. In line with this approach, and a little less recently, STS contributions have brought an important contribution to the study of the privatization of Internet governance (which Laura DeNardis has explored in several scholarly contributions, the latest in chapter 1)—that is, how decisions and actions that apply to governance are increasingly taken by private entities, in particular by the handful of giant tech companies such as Google and Facebook that, because of their size and quasi-monopolistic status, are in the position of setting *de facto* standards in policy-related arenas. As Rikke Frank Jørgensen explains in chapter 8, the privatization of Internet governance also poses methodological challenges

for the (STS) researcher, due to the heavy dimension of industrial secrecy surrounding the activities of tech giants. Furthermore, as Hall and colleagues underline in chapter 6, the omnipresence, pervasiveness, and sheer amount of data produced and available in digital form, and the multiplicity of methods at the disposal of Internet companies to make sense of it, add further implications to the privatization of Internet governance in terms of informational asymmetry, privacy challenges, and surveillance.

Another way in which STS approaches add to institutional perspectives on Internet governance is the acknowledgment of the central role of invisible, mundane, and taken-for-granted practices in the constitution of design, regulation, and use of technology. It calls attention to, for example, acts of individuals in articulating Internet standards and to how instability was built into the early Internet so as to ensure the possibility of constant change (Braman 2016), the social aspects of crafting and enacting Internet-related policy, and how nontraditional forms of participation in discourse about Internet governance issues (i.e., multistakeholderism) become institutionalized (Epstein 2013). This part of STS approaches suggests that governance of the Internet, as a socio-technical system, is a social dynamic as well as a political one.

STS-informed approaches to Internet governance also address the structuring and performative effects of controversies on governance. Most prominently, they analyze how controversies around claims, made by different actors or groups, about “doing Internet governance” actually contribute to the creation of different worlds where specific notions of governance make sense (Epstein, Katzenbach, and Musiani 2016). Thus, the study of controversies unpacks governance as a theoretical and operational concept by exposing the plurality of notions it refers to and the consequences of their being in conflict (Cheniti 2009a; Ziewitz and Pentzold 2014). The very processes by which norms are created, renegotiated, put to the test, and realigned and raise conflicts are as crucial—and perhaps more crucial—in STS perspectives as the stabilized norms themselves (De Filippi and Loveluck 2016; Musiani, Mallard, and Méadel 2018).

As hinted earlier in the chapter, several concepts brought in by the STS toolbox can help unveil a number of situated practices on, by, and for the Internet that arguably constitute a vital part of doing Internet governance. For example, understanding Internet governance through the lens of Callon, Lascoumes, and Barthe’s hybrid forums (2009)—entities meant to transform controversies into productive dialogue and bring about democracy—can

enrich and revisit the concept of multistakeholderism (Malcolm 2008) by putting emphasis on actors' positioning and their evolving relationships to one another. The technology-embedded nature of most types of private sector interventions in Internet governance can be brought to the foreground by STS methods. Examining the relationship of Internet users with their devices and the values they embed does governance inasmuch as it reflects their commitment to a set of norms and to a community (Elkin-Koren 2012).

The final part of this chapter addresses in more detail two of these key aspects that, given the current social, economic, and political context in which the Internet as a device-of-devices is placed, we consider as particularly important and gaining traction among the lenses on Internet governance. The first is the structuring and performative effect of controversies on governance; the second is the agency of nonhuman actors and infrastructures as loci where governance is enacted and mediated.

### **Controversies and Their Performative Role in Internet Governance**

Since the very early days of the Internet, being on and managing the network of networks has been about exercising control over particular functions of it that provide certain actors with the power and opportunity to act to their advantage; on the other hand, there is very rarely a single way to implement these functions or a single actor capable of controlling them. Thus, the Internet is controversial and contested, both target and instrument of governance, object of interest of a myriad of actors: from the most powerful and centralized to the average Internet user. Infrastructure can be understood as a fundamental place to exercise economic and political power (DeNardis and Musiani 2016, 3). Exposing these manifestations of power, which is often implicit and overlooked, is crucial in revealing conflicts and controversies about what an infrastructure is, who can benefit from it, or who can challenge it (Bernards and Campbell-Verduyn 2019).

Studying Internet-governance-related controversies (Pinch and Leuenberger 2006) is becoming one of the principal STS-informed ways to unpack Internet governance. Indeed, the Internet exhibits an increasing amount of contestation, in areas such as the interconnection agreements between Internet service providers (Meier-Hahn 2015), the debate around net neutrality (Marsden 2017), the use of deep packet inspection (Mueller, Kuehn, and Santoso 2012), the deployment of content filtering technologies

(Deibert and Crete-Nishihata 2012), ubiquitous surveillance measures, and the use of the DNS for regulatory aims (DeNardis and Hackl 2015). Furthermore, contentious politics, activism, and citizen-led protests are often embedded in the Internet and its applications, illustrated, for example, by the work of Milan and Ten Oever (2017) on civil society engagement within ICANN so as to encode human rights into Internet infrastructure or Ksenia Ermoshina's (2016) research on the shaping and use of citizen- and activist-oriented mobile and web applications and how the design of these tools shapes citizen participation and citizen-state interaction.

To put it in the words of Ziewitz and Pentzold (2010), controversies unveil different versions, according to different actors, of the worlds where notions of governance take place. Thus, for the analyst, the negotiations and controversies that take place around claims of "Internet governing" (Cheniti 2009b) can be viewed as performative, inasmuch as they "both implicate and are implicated in creating the worlds in which a mode of governance makes sense" (Ziewitz and Pentzold 2010, 20).

Internet governance is particularly suited to all kinds of exit strategies and evolutions in power balances; thus, consensus-based modes of regulation become central, as norms cannot be totally binding and are permanently negotiated and challenged (Brousseau, Marzouki, and Méadel 2012, 35). As a consequence, the very processes by which norms evolve—put to the test and made the subject of conflict and realignment, destabilization and restabilization—become central because they provide different types of guarantees to the various stakeholders. Digital technologies themselves play a key role in this legitimation process because they become not only facilitators but guarantors of fairness and neutrality in controversial moments of these processes, as illustrated by research on the blockchain subtending Bitcoin (Musiani et al. 2018). In doing so, they also perform trust, both by automating procedures and by keeping track of all actions.

Contrary to what some institutional approaches may suggest, controversy, unsettling, destabilization, and restabilization are important parts of Internet governance institutions as well. For example, as Flyverbom (2011) shows, the Internet Governance Forum and other Internet governance organizational arrangements would not have been born without ample reconfigurations of two UN-linked entities (the Working Group on Internet Governance and Information and Communication Technologies Task Force). If examined through an STS lens, institutions show their ability to

renegotiate and reconfigure themselves in moments of controversy in order to maintain momentum and, ultimately, authority. If not analyzed in such a light, the authority of Internet governance institutions would “otherwise come across as *faits accomplis*” (Flyverbom 2011, 6). Furthermore, as Julia Pohle (2016) argues, by focusing the analysis on actors’ positionings and negotiations, and on processes rather than outcomes, it is possible to shed light on the contribution of multistakeholder processes and the validity of their results, albeit in the absence of binding outcomes.

Internet governance controversies and battles happen most of the time over “control points,” as illustrated by Laura DeNardis (2014, 11). These control points range from the deepest layers of Internet infrastructure to the “last mile” of user access to the network, from the blocking of financial flows to the deliberate “kill-switches” of Internet-based services, from the “graduated response” termination of domestic Internet access to the attempted use of the DNS for copyright enforcement purposes, and from the Internet’s backbone infrastructure to the establishment of interconnection agreements. They also include the *de facto* public policy role assumed by private information intermediaries, in the many ways they gather, collect, aggregate, select, and present data to users and to other actors of the Internet value chain—thereby enacting governance over privacy, freedom of expression, cultural diversity, and reputation (DeNardis 2012, 2014).

### **Infrastructure as Enacting and Mediating Governance**

The term “infrastructure,” as Sandra Braman’s chapter 2 notes, is a potentially all-encompassing term that may be excessively vague without a definition. It commonly refers to the collective equipment necessary to human organization and activity, such as buildings, roads, bridges, and communications networks—in short, fully material and concrete artifacts. However, when it comes to the Internet (and its governance), Geoffrey Bowker and colleagues note that “beyond bricks, mortar, pipes or wires, infrastructure also encompasses more abstract entities, such as protocols (human and computer), standards, and memory,” as well as “digital facilities and services ... [such as] computational services, help desks, and data repositories to name a few” (Bowker et al. 2010, 97–98).

According to a body of work that draws inspiration from the research of Bowker and that of his colleagues, in particular Susan Leigh Star, the

infrastructural quality of the network of networks is relational and conditional; infrastructures can be more usefully understood in terms of function than form. Thus, beyond objects whose infrastructural aspect is immediately obvious, such as bridges or pipes, a number of artifacts and entities that populate and shape the network of networks could be described as infrastructure because they have an infrastructural *function*—because they help structure, shape, enable, or constrain our being together on and with the Internet. In this sense, Internet infrastructures include physical objects—for example, submarine cables that carry global telecommunications, data centers that host digital content, and objects that are a priori much less concrete, such as the Internet protocol that allows the blockchain underlying Bitcoin to work.

A whole tradition of STS have explored the social and organizational dimensions of infrastructure of information and communication technologies, intended, thus, in these multiple senses of not only the purely material artifacts but also their logistical substrata. In particular, STS scholars have highlighted features that are of interest when studying complex socio-technical systems—for example, that infrastructure typically exists in the background, is invisible, and is frequently taken for granted (Star and Ruhleder 1994). Thus, it is argued, the politics inscribed in infrastructure by means of design and technical encodings is similarly difficult to trace. Yet it is an important task because the design of the “plumbing” of the Internet (Musiani 2012), the underlying practices, uses, and exchanges in a networked system, informs its adoption and (re)appropriation by users, its regulation, and its organizational forms. Several bodies of work, crossing Internet studies with the branch of STS called infrastructure studies, have sought to explore the social and organizational qualities of infrastructures subtending information networks and to find the materiality in the virtual of software and code (Blanchette 2011; Fuller 2008; Marino 2006). New concepts to account for the agency of infrastructure have been proposed, such as Annalisa Pelizza’s “vectorial glance” (2016), which explores how interoperability of information systems, as a performative process of boundary reordering, redistributes authority and accountability: the small technical operations of interoperability projects become strategic sites where institutional shifts become visible.

STS-informed perspectives examining infrastructures have proliferated, but they at first received comparatively little attention from scholars of Internet *governance*, the pioneer in this regard having been Laura DeNardis with her article “Hidden Levers of Internet Control” (2012). They are now

an important part of Internet governance scholarship, as contributions by Braman (2016) and Malcic (2016), on the work of the Internet's early designers, and De Filippi and Loveluck (2016), on the mixed technical and social governance subtending Bitcoin, have shown. In these contributions, Internet governance is understood as a set of socio-technical processes of innovation, digitalization, regulation, mobilization, co-optation, and circumvention.

Furthermore, contributions drawing from STS approaches in recent years have recognized not only that administrative and coordinating functions related to Internet infrastructure have always been instruments of power (DeNardis 2009) but that points of infrastructural control, regardless of their originally intended function, can serve as proxies to regain (or gain) control of or manipulate the flow of money, information, and the marketplace of ideas in the digital sphere—a phenomenon that has been called the “turn to infrastructure in Internet governance” (Musiani et al. 2016). This body of work addresses, for example, the use of the DNS as a tool for intellectual property rights enforcement (Merrill 2016) or information intermediaries' discretionary power to set their infrastructural practices to prioritize strategic interests over privacy commitments (Sargsyan 2016). Put together, these contributions show a shift from a “values-in-design” approach (Flanagan, Howe, and Nissenbaum 2008) to a politicization of Internet governance infrastructures (DeNardis 2009). That is to say, while values have entered the design of infrastructure for a long time, these values have been incorporated into technological infrastructure mostly to carry out its core functions; instead, the use of Internet infrastructure to carry out functions other than their intended objective can lead to important collateral damage for the stability and security of the Internet and the protection of online civil liberties (DeNardis and Musiani 2016). STS approaches, with their attention to situated practice and infrastructural agency, are well suited to bring these aspects to the foreground.

### **What Can STS Approaches Do for Internet Governance Research?**

STS-informed analyses of the construction, materiality, and controversial potential of digital infrastructures offer new insights into the scope and limits of Internet-related technological change and its governance potential for at least two reasons.

First, the emphasis on the infrastructural nature of socio-technical systems makes it possible to shed new light on how the applications of alternative

and emerging technologies mingle with dominant actors, objects, and processes. Infrastructure, as Star (1999, 382) puts it, does not develop from scratch but struggles with the inertia of what is already stabilized and inherits its strengths and limitations. Approaches to Internet infrastructure and its political weight also help explicitly highlight the contested and relational nature of technological change. New technologies do not change Internet operations on their own. On the contrary, technological change is mediated through fundamentally political struggles over the functioning and nature of the systems required to perform these infrastructural functions.

Second, highlighting efforts to position networked digital systems as material and infrastructural invites us to consider the contradictions of technological change. The denaturalization of socio-technical systems, making them black boxes, draws attention to these systems being flawed and subject to the possibility of failure. Star points out how the normally invisible quality of infrastructures becomes visible when they collapse (1999, 382). We are, for example, much more likely to notice our dependence on the electricity grid during a power cut than when everything is working as normal. The same could be said of systems that connect individuals, allow them to connect to the broadband Internet, convert purely digital addresses into addresses more intelligible for the human brain, or shape the blockchain.

As manifestations of failure, however, the material and process failures that underlie socio-technical systems are not only relevant in the instability that unmask them. On the contrary, they are always important. Boundaries contributing to “infrastructure inequality” (Nelms 2016, 511) can help bring forward broader issues of access and can problematize information that can be standardized and operationalized and that which cannot. In a nutshell, it is by analyzing the politics of technological infrastructures and basing them in their materiality that we avoid implicitly and explicitly fetishizing the novelty of new technologies and develop a more nuanced perspective to understand what ultimately constitutes questionable—and, indeed, contentious—models of continuity and change.

If there is but one insight about Internet governance research to take away from this chapter, it is that, when examined through the STS lens, the Internet is not a given, static technological entity in need of regulation; it is the ensemble of technological elements of the network of networks and the different actors doing things with it that constitute, perpetuate, and contest sociopolitical order. In addition to the technical decisions about the design

and operation of the network, formal law and regulation, and the forces of the market, a number of rather mundane and taken-for-granted activities, driven by heterogeneous and often competing visions or based on inherently social and political arrangements of trust and consensus, contribute to Internet governance as it is today.

## Conclusion

As the Internet more and more becomes humanity's primary global facility, marketplace, and public sphere, sociopolitical and socio-technical controversies become an increasingly important part of what lies under the Internet governance label. The STS toolbox provides one of the most interesting opportunities for them to be thoroughly accounted for, richly described, and extensively analyzed, with notions that are both *concepts* (they suggest a vision of how the world goes, what drives its operations, and what makes them meaningful in political terms) and *methods* (each of these notions is also a practical way to apprehend the inner workings of Internet governance on the field). In this sense, recent research seeking to merge STS and Internet governance is indeed a blueprint for a controversy-based and infrastructure-based understanding of the backstage of today's Internet politics.

STS methods come, of course, with their own set of challenges. Looking at the mundane, the "shaping invisible" (Musiani 2018), which usually escapes the public radar—often even the scholarly radar—implies identifying the right terrain, singling out the ways to get to it, and finally patiently negotiating access to it (see Jørgensen's chapter 8), because an in-depth ethnographic work is a necessary precondition to a meaningful STS endeavor. This negotiation is, sometimes, not with potential fieldwork actors but with the researcher's own set of competences: to analyze and, more, to clearly *analytically describe* environments requires a high level of technicality that first needs to be mastered by the researcher. Thus, STS researchers of Internet governance (as is the case for many scholars of the governance of other technical systems and devices) often have composite disciplinary backgrounds, having arrived to STS methods only after previous training in computer science and engineering.

The choice of which fieldwork to address in depth—usually one or a few case studies—brings with it questions of criteria selection for that choice and of the representativeness of the selected cases. And finally, closely related to the previous point—despite the difficulty of generalizing to broader principles,

which is intrinsic to the STS approach—for their work to be meaningful in a broader dialogue with other disciplines, STS-inspired Internet governance researchers should guard against falling into a common trap of their discipline of disciplines: making the language of complexity and heterogeneity the main protagonist of their analyses to the point of clouding conclusions behind it.

The increasing attention dedicated by STS scholars to the Internet governance field has not, of course, grown in isolation. In addition to the lineage of Internet studies introduced earlier in the chapter, a significant body of existing STS literature provides insights into distributed participation in techno-scientific controversies, and Internet governance research can learn from governance of and *by* science and technology in other contemporary, complex socio-technical domains such as environment, health, nanotechnologies, and genetic engineering (see, e.g., Irwin 2006). Similarly, Internet governance research in other, more historical disciplines, mainly focused on the institutional level and the role of the state—political science, law, history, international relations, and institutional economics—can speak to STS and help, for example, mitigate some of the undesired consequences of STS approaches described earlier.

The nexus between STS-inspired Internet governance studies and other bodies of STS on infrastructures and socio-technical controversies is likely to become even more inextricably entangled as the reach of Internet infrastructure actors extends to other types of infrastructures. Larry Page once predicted that “Google would be building airports and cities,” and the Internet giants are readying to extend themselves: while it has long been believed that the influence of digital actors would remain confined to software, dematerialized content, and information, it starts to be clear that they are using their mastery in these areas to take positions in non-digital markets, be it transport, infrastructure management, or banking. Google may not be building cities yet, but directly or through its investments it is already playing a role as a mobility organizer. IBM participates in the management of water supply infrastructure in several cities. With the connection of infrastructures and objects, the organization of physical flows requires the control of information flows. Massive data are at the heart of this movement, which calls into question the positions of the historical players in these markets. Internet governance and its study in the near future should take into account these ongoing developments about the perimeter and the very nature of Internet infrastructure, just as, in the

recent past, they started to acknowledge the shift from governance *of* Internet infrastructure to governance *by* infrastructure.

The STS focus on unpacking some of the mundane elements of the Internet—such as technical details and minutiae, invisible maintenance work, specific case studies, and close follow-ups of controversies—is a necessary complement, not a substitute, to those efforts that seek to elaborate general principles and theories about the ways in which the distribution of power and resources, in short, the world of politics and governance, works.

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### Note

1. A debate is ongoing among STS Internet governance scholars on whether user agency and practice should be included in Internet governance, Laura DeNardis (2014) notably saying it should not be included. Interestingly, as Mueller and Badiei in chapter 3 show, this uncertainty about whether certain user practices should or should not be included in Internet governance may account for its underrepresentation as a research topic in sociology and social sciences journals, because several sociologists are in fact studying issues relevant to Internet governance without labeling it as such.

### References

- Abbate, J. (2012). L'histoire de l'Internet au prisme des STS. *Le temps des médias*, 18, 170–180.
- Bernards, N., & Campbell-Verduyn, M. (2019). Understanding technological change in global finance through infrastructures: Introduction to Review of International

Political Economy Special Issue "The Changing Technological Infrastructures of Global Finance." *Review of International Political Economy*, 26(5), 773–789. doi.org/10.1080/09692290.2019.1625420

Blanchette, J.-F. (2011). A material history of bits. *Journal of the Association for Information Science and Technology*, 62(6), 1042–1057.

Bowker, G. C., Baker, K., Millerand, F., & Ribes, D. (2010). Toward information infrastructure studies: Ways of knowing in a networked environment. In J. Hunsinger, L. Klastrup, and M. Allen (Eds.), *International Handbook of Internet Research* (pp. 97–117). Dordrecht, Netherlands: Springer.

Braman, S. (2016). Instability and Internet design. *Internet Policy Review*, 5(3). doi:10.14763/2016.3.429

Brousseau, E., Marzouki, M., & Méadel, C. (Eds.). (2012). *Governance, regulation and powers on the Internet*. Cambridge, UK: Cambridge University Press.

Callon, M., Lascoumes, P., & Barthe, Y. (2009). *Acting in an uncertain world: An essay on technical democracy*. Cambridge, MA: MIT Press.

Cheniti, T. (2009a). *Global Internet governance in practice: Mundane encounters and multiple enactments* (Unpublished doctoral dissertation). University of Oxford, UK.

Cheniti, T. (2009b, March). *Internet governanc-ing*. Paper presented at the Modes of Governance in Digitally Networked Environments Workshop, Oxford Internet Institute, Oxford, UK.

De Filippi, P., & Loveluck, B. (2016). The invisible politics of Bitcoin: Governance crisis of a decentralized infrastructure. *Internet Policy Review*, 5(3). doi:10.14763/2016.3.427

de Fornel, M. (1994). Le cadre interactionnel de l'échange visiophonique. *Réseaux*, 64, 107–132.

Deibert, R. J., & Crete-Nishihata, M. (2012). Global governance and the spread of cyberspace controls. *Global Governance: A Review of Multilateralism and International Organizations*, 18(3), 339–361.

DeNardis, L. (2009). *Protocol politics: The globalization of Internet governance*. Cambridge, MA: MIT Press.

DeNardis, L. (2012). Hidden levers of Internet control: An infrastructure-based theory of Internet governance. *Journal of Information, Communication & Society*, 15(3), 1–19.

DeNardis, L. (2014). *The global war for Internet governance*. New Haven, CT: Yale University Press.

DeNardis, L., & Hackl, A. M. (2015). Internet governance by social media platforms. *Telecommunications Policy*, 39(9), 761–770. doi:10.1016/j.telpol.2015.04.003

- DeNardis, L., & Musiani, F. (2016). Introduction: Governance by infrastructure. In F. Musiani, D. L. Cogburn, L. DeNardis, & N. S. Levinson (Eds.), *The turn to infrastructure in Internet governance* (pp. 3–21). New York, NY: Palgrave Macmillan.
- DiMaggio, P., Hargittai, E., Neuman, W. R., & Robinson, J. P. (2001). Social implications of the Internet. *Annual Review of Sociology*, 27(1), 307–336.
- Elkin-Koren, N. (2012). Governing access to user-generated content: The changing nature of private ordering in digital networks. In E. Brousseau, M. Marzouki, C. Méadel (Eds.), *Governance, regulations and powers on the Internet* (pp. 318–343). Cambridge, UK: Cambridge University Press.
- Epstein, D. (2013). The making of institutions of information governance: The case of the Internet Governance Forum. *Journal of Information Technology*, 28(2), 137–149.
- Epstein, D., Katzenbach, C., & Musiani, F. (2016). Doing Internet governance: Practices, controversies, infrastructures, and institutions. *Internet Policy Review*, 5(3). doi:10.14763/2016.3.435
- Ermoshina, K. (2016). *Au code, citoyens: Mise en technologie de problèmes publics* (Unpublished doctoral dissertation). MINES ParisTech.
- Flanagan, M., Howe, D. C., & Nissenbaum, H. (2008). Embodying values in technology: Theory and practice. In J. van den Hoven & J. Weckert (Eds.), *Information technology and moral philosophy* (pp. 322–353). Cambridge, UK: Cambridge University Press.
- Flyverbom, M. (2011). *The power of networks: Organizing the global politics of the Internet*. Cheltenham, UK: Edward Elgar.
- Flyverbom, M. (2016). Disclosing and concealing: Internet governance, information control and the management of visibility. *Internet Policy Review*, 5(3). doi:10.14763/2016.3.428
- Fuller, M. (Ed.). (2008). *Software studies: A lexicon*. Cambridge, MA: MIT Press.
- Gillespie, T., Boczkowski, P., & Foot, K. (Eds.). (2014). *Media technologies: Essays on communication, materiality and society*. Cambridge, MA: MIT Press.
- Hofmann, J., Katzenbach, C., & Gollatz, K. (2016). Between coordination and regulation: Finding the governance in Internet governance. *New Media & Society*, 19(9), 1406–1423.
- Irwin, A. (2006). The politics of talk: Coming to terms with the “new” scientific governance. *Social Studies of Science*, 36(2): 299–320.
- Law, J. (1992). Notes on the theory of the actor-network: Ordering, strategy, and heterogeneity. *Systems Practice*, 5(4), 379–393.
- Mager, A. (2012). Algorithmic ideology: How capitalist society shapes search engines. *Information, Communication & Society*, 15(5), 769–787.
- Malcic, S. (2016). The problem of future users: How constructing the DNS shaped Internet governance. *Internet Policy Review*, 5(3). doi:10.14763/2016.3.434

Malcolm, J. (2008). *Multi-stakeholder governance and the Internet Governance Forum*. Wembley, Australia: Terminus Press.

Marino, M. C. (2006). Critical code studies. *Electronic Book Review*. Retrieved from <http://www.electronicbookreview.com/thread/electropoetics/codology>

Marsden, C. T. (2017). *Network neutrality: From policy to law to regulation*. Manchester, UK: Manchester University Press.

Meier-Hahn, U. (2015, February 5). Internet interconnection: Networking in uncertain terrain [Blog post]. *RIPE Labs*. Retrieved from [https://labs.ripe.net/Members/uta\\_meier\\_hahn/internet-interconnection-networking-in-uncertain-terrain](https://labs.ripe.net/Members/uta_meier_hahn/internet-interconnection-networking-in-uncertain-terrain)

Merrill, K. (2016). Domains of control: Governance of and by the domain name system. In F. Musiani, D. L. Cogburn, L. DeNardis, & N. S. Levinson (Eds.), *The turn to infrastructure in Internet governance* (pp. 89–106). New York, NY: Palgrave Macmillan.

Milan, S., & ten Oever, N. (2017). Coding and encoding rights in Internet infrastructure. *Internet Policy Review*, 6(1). doi:10.14763/2017.1.442

Mueller, M. L., Kuehn, A., & Santoso, S. M. (2012). Policing the network: Using DPI for copyright enforcement. *Surveillance & Society*, 9(4), 348–364.

Musiani, F. (2012). Caring about the plumbing: On the importance of architectures in social studies of (peer-to-peer) technology. *Journal of Peer Production*, 1. Retrieved from <http://peerproduction.net/issues/issue-1/peer-reviewed-papers/caring-about-the-plumbing/>

Musiani, F. (2015). Practice, plurality, performativity and plumbing: Internet governance research meets science and technology studies. *Science, Technology and Human Values*, 40(2): 272–286.

Musiani, F. (2018). L'invisible qui façonne. Etudes d'infrastructure et gouvernance d'Internet. *Tracés*, 35, 161–176.

Musiani, F., Cogburn, D. L., DeNardis, L., & Levinson, N. S. (Eds.). (2016). *The turn to infrastructure in Internet governance*. New York, NY: Palgrave Macmillan.

Musiani, F., Mallard, A., & Méadel, C. (2018). Governing what wasn't meant to be governed: A controversy-based approach to the study of governance in Bitcoin. In M. Campbell-Verduyn (Ed.), *Bitcoin and beyond* (pp. 133–156). London, UK: Routledge.

Musiani, F., & Méadel, C. (2016). "Reclaiming the Internet" with distributed architectures: An introduction. *First Monday*, 21(12). Retrieved from <http://firstmonday.org/ojs/index.php/fm/article/view/7101>

Musiani, F., Pelizza, A., & Milan, S. (2016). Materializing Governance by Infrastructure. *4S Preview Blog*. Retrieved from [http://www.4sonline.org/blog/post/materializing\\_governance\\_by\\_infrastructure](http://www.4sonline.org/blog/post/materializing_governance_by_infrastructure)

- Musiani, F., & Schafer, V. (2019). Science and technology studies approaches to web history. In N. Brügger & I. Milligan (Eds.), *Handbook of Web History* (pp. 73–85). Thousand Oaks, CA: Sage.
- Nelms, T. C. (2016). Alt. economy: Strategies, tensions, challenges. *Journal of Cultural Economy*, 9(5), 507–512.
- Pelizza, A. (2016). Developing the vectorial glance: Infrastructural inversion for the new agenda on governmental information systems. *Science, Technology and Human Values*, 41(2), 298–321.
- Pinch, T., & Leuenberger, C. (2006). *Studying scientific controversy from the STS perspective*. Paper presented at the Science Controversy and Democracy Conference, Taipei, Taiwan.
- Pohle, J. (2016). Multistakeholder governance processes as production sites: Enhanced cooperation “in the making.” *Internet Policy Review*, 5(3). doi:10.14763/2016.3.432
- Proulx, S. (2009, June). L’intelligence du grand nombre: la puissance d’agir des contributeurs sur Internet—limites et possibilités. *7ème colloque du chapitre français de l’ISKO, Intelligence collective et organisation des connaissances*, Lyon, France. <http://pro.ovh.net/~iskofran/pdf/isko2009/PROULX.pdf>
- Sargsyan, T. (2016). The privacy role of information intermediaries through self-regulation. *Internet Policy Review*, 5(4). doi:10.14763/2016.4.438
- Star, S. L. (1999). The ethnography of infrastructure. *American Behavioral Scientist*, 43(3), 377–391.
- Star, S. L., & Griesemer, J. (1989). Institutional ecology, “translations” and boundary objects: Amateurs and professionals in Berkeley’s Museum of Vertebrate Zoology, 1907–39. *Social Studies of Science*, 19(3), 387–420.
- Star, S. L., & Ruhleder, K. (1994). Steps towards an ecology of infrastructure: Complex problems in design and access for large-scale collaborative systems. *Proceedings of the Conference on Computer Supported Cooperative Work* (pp. 253–264). Chapel Hill, NC: ACM Press.
- Trompette, P., & Vinck, D. (Eds.). (2009). Retour sur la notion d’objet-frontière. *Revue d’anthropologie des connaissances*, 3(1), 5–27.
- Woolgar, S., & Neyland, D. (2013). *Mundane governance: Ontology and accountability*. Oxford, UK: Oxford University Press.
- Ziewitz, M. (2016). Governing algorithms: Myth, mess, and methods. *Science, Technology and Human Values*, 41(1), 3–16.
- Ziewitz, M., and Pentzold, C. (2010, October). *Modes of Governance in Digitally Networked Environments: A Workshop Report* (Discussion Paper No. 19). Oxford, UK: Oxford Internet Institute Forum.
- Ziewitz, M., and Pentzold, C. (2014). In search of Internet governance: Performing order in digitally networked environments. *New Media & Society*, 16(2), 306–322.