Science and Technology Studies Approaches to Web History

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Introduction

A decade ago, Barry Wellman affirmed that the mid-Nineties had corresponded to the « prehistoric » era in the emerging field of study seeking to explore, analyse and understand the complexity of the social, legal, political and economic relations subtending the development of the Internet (Wellman, 2004: 127). This approach goes hand in hand with Web development, and this interest in renewed approaches to Internet studies is most likely related to the widespread diffusion of the Internet allowed by the Web in the late Nineties. Leveraging approaches issued from science and technology studies (STS), researchers have progressively emphasized a critical approach to the complex nexus of Internet and society. More recently, Janet Abbate (2012: 170) 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.

This chapter introduces STS approaches applying them to Web history, with the intent to show

how they can shed further light on it and enrich it. In its first part, the chapter introduces key STS concepts and notions such as agency, co-construction, *dispositif*, actor-network, boundary object (Star and Griesemer, 1989), controversy and trial, and links them to case studies and examples drawn from the history of the Web such as the creation of W3C, the rise of spam, gifs and memes, the development of Wikipedia, the role of APIs. The second part of the chapter delves into the governance of the Web as a particularly interesting case study of how STS notions and concepts can be leveraged to advance the analysis of objects and dynamics central to the Web and its history. Important Web governance-related concepts, such as multi-stakeholderism (Malcolm, 2008) and algorithmic governmentality (Rouvroy and Berns, 2013), are 'put to the test' through a STS lens.

This chapter seeks to show the value of a relational, practice-oriented approach – what in STS vocabulary is called 'unpacking black boxes,' or doing a sociology 'of assemblages.' The chapter examines how this approach can shed light on the hybrid mobilisations of innovators, consumers, users and entrepreneurs – alongside their creations and cultures – that have made the Web the complex socio-technical system it is today.

<h1> **When STS and Web history meet** <h1>

The encounter between the field of science and technology studies (STS) and the Internet as a subject of study has already proven interesting and fertile in recent times. Notably, an emerging field of study is born in the bridging of STS and Internet governance research. Thus, it is interesting to revisit the history of the Web, and more generally of the Internet, through the lens of key concepts in STS. The first part of this chapter aims at demonstrating the effectiveness of a few core STS concepts in the field of Web history. The meeting of STS and the Web first happened with studies of information and communication technologies (ICTs), the Internet in particular. Thus, as a background to this endeavor, the chapter first retraces this meeting, and proceeds to show that more recently, STS have crossed paths with media studies, thus reinforcing the nexus between approaches to the communication field in its past and present dimensions.

<h2> *When STS meet ICTs* <h2>

The '*STS turn'* is founded in sociology of innovation's interest for technical objects and for social practices of appropriation of emerging technologies, in media sociology's increasing interest in ICTs, and the development of information and communication sciences: ICTs become 'interactional artifacts' (de Fornel, 1994: 126). With the advent of the Internet, then of the Web, an 'object-centered,' interdisciplinary field of study follows at the end of the Nineties, 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 and Web innovation. STS approaches put emphasis on the practices that shape the management and the governance of the Internet and its uses as a living reality, and determine the ways in which it

operates, works, resists, functions. Furthermore, STS approaches invite not to consider values and rationalities of Internet and Web practitioners as *indicators* of how they perceive the world, but problematize them 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.

When STS meet media studies

Several disciplines have attempted to 'think themselves anew' through the STS lens, or proposed conceptual hybrids. Noortje Marres and Carolin Gerlitz (2015) argue, for example, that digital social research should adopt 'interface methods' – a 'critical and creative engagement with methods development at the intersection of sociology, STS and digital research,' despite the strong bias in favor of purely quantitative methods that currently informs research on digital media (Marres & Gerlitz, 2015).

Even more recently, Gabriele Balbi, Alessandro Delfanti and Paolo Magaudda (2016, eds.) have facilitated a conversation on the cross-fertilization of STS and media studies approaches (Badouard et al., 2016). The convergence between the two fields is revealed to be far from linear, with numerous points of friction appearing and notions such as *dispositif* (which we will come back to later in more detail) revealing their multiple meanings. However, several objects and sensibilities are shared by media studies and STS, especially in terms of common ancestors – e.g.

domestication theory as discussed by Oudshoorn and Pinch (2003) – or a shared interest on infrastructures. All these contribute to the dialogue of the sociology (and the history) of the Web, and STS. Their encounter is, in particular, driven by the concept of materiality.

As Balbi et al. (2016) note, the 'material' and 'physical' aspects of social life have been a crucial object of investigation for STS since the inception of the field. A 'material turn' in the study of the Internet and ICTs is fostered by hybrid work between STS and media and communication studies (Hondros ed., 2015). This work has not always been linear, as Lievrouw (2014) notes, due to STS's and media studies' respective tendencies to give prominence to different processes – the co-determinism of the social and the material for STS, versus media studies' understanding of technology's materiality as a product of discourses and visions. However, it is increasingly producing notable work, such as Parikka's media archeology (2012) and Gitelman et al.'s work (2013) on the infrastructures subtending data.

Badouard et al. (2016), drawing from Latour and Callon's 'classic' STS literature, observe that STS have helped recognize technical artefacts' status of '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 as co-constructing each other (Gillespie et al., 2014; Lievrouw and Boczkowski, 2007).

The notion of *dispositif* (in the Foucaldian sense, often translated as 'device' in English) and boundary object are among the notable concepts at the intersection of media studies and STS. In classic actor-network theory vocabulary, a socio-technical *dispositif* (device) is defined as an assemblage of human and non-human actants, where competencies and performances are distributed, and whose existence is enabled by the workings of innovation. Moreover, the notion allows to integrate agency (Proulx, 2009) in the analysis, for a more fine-grained appreciation of its collective dimension. As Muniesa et al. (2007) point out, 'devices do things. They articulate actions, they act or make others act,' they make phenomena of translation materially possible. Several authors have underlined the suitability of the 'device' notion to be expanded beyond the strictly Foucaldian focus on power relations, social control, disciplinary and normative connotations. Indeed, the more recent uses of the notion by social science researchers call for a reflection on the different forms of tension and mediation that articulate and interact in a number of constantly-evolving media, digital and communication devices, including the Web (Appel, Boulanger and Massou, 2010).

When Web history meets STS concepts: the example of 'boundary objects'

Concepts such as *dispositif* and mediation prove useful to articulate STS and media studies in a pragmatic approach to the 'power relations' inscribed in information and communication tools, as Badouard et al. conclude in (2016). Indeed, the notions of mediation and re-mediation can usefully be applied to the Web and to its archives – that increasingly act as sources for historians. In previous, recent work, we have showed the extent to which mediations and agencies need to be

taken into account in order to think the Web of the past and the archived Web:

> Technical and human negotiations at both levels of collection and consultation of the Web archive include many operations: the choices of particular crawl frequencies, depths, domains to be collected, programming of robots, data deduplication processes; the recreation of links and filling of URLs by the access software; the exclusion of specific elements such as advertisements; the creation of platforms and consultation environments offering different designs and functionalities. All these operations bear witness to the ongoing choices that reflect the scope and ambitions established by and for the actors of Web archiving (Schafer, Musiani and Borelli, 2016).

We can attempt to go further, by showing how several features of born-digital heritage allow us to qualify it as a boundary object, i.e. the concept coined by Susan Leigh Star and James Griesemer (1989) to analytically describe those processes where actors coming from different social worlds, and called upon to cooperate, manage to coordinate despite their diverging points of view: 'how do they create mutual understandings without losing the diversity of social worlds?' (Trompette and Vinck, 2010: 6-7). This concept was meant to reduce the inherent asymmetry enshrined in Michel Callon's original 'translation' notion (1986): from a top-down initiative by the innovator or the science entrepreneur, enrolling other actors by exerting control via mandatory passage points, to a more organic view taking into account the co-existence of several translation processes.

This notion is, indeed, to be handled with care – as Susan Leigh Star herself suggests in a subsequent article (2010): since its creation, the concept has mostly been used for its 'interpretive flexibility,' i.e. the property that allows it to operate as a support of heterogeneous translations, a device of integration for different types of knowledge, of mediation in the processes of coordination of experts and amateurs. However, as Trompette and Vinck (2010) emphasize, other dimensions have been unjustly overlooked or downright forgotten; for example, boundary objects incorporate sets of conventions, standards, norms, typical of specific communities of practice and allow to account for the processes of delegation of work or other activities, or for the performative action of artifacts in the production of knowledge. By fully re-instating these dimensions, one is able to account more broadly for the work of coordination, alignment, alliance and translation between the different actors and the worlds they mobilize.

The notion of boundary object, seen in this light, can be applied to the study of born-digital heritage on the Web and beyond the Web, e.g. the discussion lists, newsgroups and websites of the early Nineties. For instance, with a view to reconstruct the trajectories of innovation within pioneering user groups, Camille Paloque-Bergès (2016) highlights the uses of these technologies in the mid-1990s, and observes that they served a logic of confrontation to social, political and economic norms – such as, respectively, rules of sociability in online public speaking, equipment and techno-scientific development, governance and regulation of networks, and the transition from non-commercial networks to a full-fledged digital economy. Interestingly, the author notes that not only the discussions, but the processes of their archiving facilitated negotiations and cooperation between programmers and pioneer users and within the programming community. Indeed, those processes helped to clarify and make explicit the reconfigurations and re-

appropriations of innovation, and contributed to the emergence of the spatial and temporal practical dimensions of innovation (Latzko-Toth, 2010).

As noted previously (Schafer, Musiani and Borelli, 2016), sufficiently 'malleable to adapt itself to the local needs and constraints of its different user-types,'capable of existing in different social worlds, all the while satisfying the 'informational needs' of each, and being sufficiently robust to maintain a common identity throughout these adaptations (Star and Griesemer, 1989), born digital heritage carries within itself the challenges of its maintenance, memory, but also of its governance, as we explore in the second part of this chapter.

The prism of boundary objects can be used to investigate several 'objects' in Web history – such as the protocols and formats that have contributed to make the Web what it is today, or the animated images GIFs. Indeed, taking the issue of formats and particularly of blogs, Ignacio Siles proposes on his end an STS entry into Web history via the notion of closure (Siles, 2011). He observes that practitioners largely consider that weblogs merged other types of sites (diaries, journals) only after 1999 as a result of the emergence of automated blogging software, considered as a defining moment in the early history of blogs. However, Siles remarks, this particular account of the history of blogs neglects other factors that STS perspectives can help to unveil. Examples of this are the conditions under which this Web 'format' emerged and how it has merged with other practices and technologies, as well as the 'shaping' role of relevant social groups of Web users (diarists, personal publishers), and more broadly the agency of users at large in appropriating both the technical and content dimensions of these sites, which paralleled the

development of the software itself. Thus, the author argues,

> Because it involved interactions between several groups of users around a technology and the partial stabilization of its meaning, this case can be conceptualized as an instance of early 'closure' (Pinch and Bijker, 1987) [, referring to] the process through which 'artifacts appear to have fewer problems and become increasingly the dominant form of the technology' (Kline and Pinch, 1996: 766). Stabilization thus designates the process through which technologies acquire material form and meaning. (Siles, 2011)

As for blog formats, the history of the Web provides myriad examples of processes and practices that contribute to attach meaning to artifacts, of different actors' engagement in the material appropriation of such artifacts, of their social and technical 'stabilization' via ongoing processes of shaping and reshaping. Web history is about the mutual shaping of content and artifacts, developers and users; STS concepts contribute to shed light on the mundane and taken-for-granted practices and discourses that constitute the design, regulation and maintenance of the Web, a system whose crucial importance in our lives today has started to be shaped by its early days in the Nineties. Ultimately, these approaches speak to, and unpack, more 'macro' issues of politics, power and governance, which will be the subject to the next section.

<h1> **Web governance history through 'an STS lens'** <h1>

This mutual shaping between artifacts and contents calls for a long-term understanding of the history of the Web and of the shaping of knowledge infrastructures. It also invites us, following Philip Agre, to explore the relation between technical architectures and institutions, particularly the difference between 'architecture as politics' and 'architecture as a substitute for politics' (Agre, 2003), an argument that is, of course, closely linked to Lawrence Lessig's famous motto 'code is law' and its offspring. Agre argues that technology often comes to us 'wrapped in histories about politics,' which raises the issue of Web governance.

The notion of Internet governance – since its first widely consensual definition elaborated at the World Summit on the Information Society in Geneva, 2003, and Tunis, 2005 – has led to a number of recent studies seeking to merge it with STS perspectives (e.g. DeNardis, 2014; Epstein, Katzenbach and Musiani, eds., 2016). In 2005, the Working Group on Internet Governance defined Internet governance as 'the development and application by Governments, the private sector and civil society, in their respective roles, of shared principles, norms, rules, decision-making procedures, and programmes that shape the evolution and use of the Internet,' adding that 'it also includes other significant public policy issues, such as critical Internet resources, the security and safety of the Internet, and developmental aspects and issues pertaining to the use of the Internet.'

This definition is centered on the Internet, not specifically on the Web; furthermore, Web governance has led to a far more limited number of studies that explicitly place this notion at their heart. However, we argue that said definition is relevant for Web governance as well, and can be usefully explored via STS tools, as we will show in the remainder of this section via three cases that speak to three levels of the Web and of its history: the 'institutional' governance of the Web as expressed in a wide standardization body such as the W3C; the governance of a Web 'system' – as speaking of a mere 'Website' may now be too reductive – i.e., the foremost online encyclopedia, Wikipedia; and finally, that of Web archiving, that has in several respects reproduced and prolonged a number of critical issues in Internet governance.

<h2> *From the CERN to the W3C* <h2>

As previously showed, STS approaches are strongly linked to the sociology of translation, and influenced by actor-network theory (Callon, 1986; Latour, 1987; Law, 1992). By proposing an analysis of the very 'practical' ways in which humans and non-humans connect and stabilize, ANT allows an articulate understanding of the interactions leading to the hybrid and unstable associations of 'the technical,' 'the political,' 'society' and 'organizations,' and their temporary stabilizations due to 'translations.' Giving center stage to technical objects in the making, to processes, to the unstable and the transient, ANT considers that the keys to understanding innovation and its politics are the process, the movement, the negotiation, rather than the object or the artifact themselves at any given moment. This framework proves useful to analyze arenas of Internet governance that are, indeed, places of constant and articulate negotiation – such as the

World Wide Web Consortium or W3C – but it also allows to re-instate the actors of Web history in its socio-technical complexity, showing how the unfolding of this history is most often about alliances and consultations with an increasing number of stakeholders.

The historian can produce an ex post socio-technical analysis of the ways in which choices were made. However, actors themselves have at times taken upon them, often in very empirical ways, to undertake a situated socio-technical analysis. As John Law noted, actors become 'heterogeneous engineers,' able to understand and support the organization of actors and objects – humans and non-humans (Law, 1987). The success of innovation, in this vision, partly relies on innovators' capacity to interest and enroll other actors around their vision of innovation and their way of articulating it (Callon, 1986).

This approach helps redefine the emergence of the Web, since the work of Tim Berners-Lee and Robert Cailliau, in a specific manner. The emergence of the W3C, further detailed by the 'Web History in Context' chapter in this book, can indeed be read according to this particular angle. Let us recall, for example, Tim Berners-Lee's decision to ask CERN to place his invention in the public domain and his preference for open innovation with equally open structures of governance (Berners-Lee, 2000). At the request of Tim Berners-Lee, CERN agreed to allow free use of Web protocols. The next year, the first international World Wide Web Conference was held at CERN, and the MIT Laboratory for Computer Science (LCS, now CSAIL) became the first host of the World Wide Web Consortium (W3C). In his introduction to *Weaving the Web*, the head of MIT-LCS, Michael L. Dertouzos, notes that 'As technologists and entrepreneurs were launching or

merging companies to exploit the Web, they seemed fixated on one question: "How can I make the Web mine?". Meanwhile, Tim Berners-Lee was asking " How can I make the Web yours?"' (Berners-Lee, 2000, viii); indeed, this citation seems to emphasize Berners-Lee's capacity to 'enroll' around open protocols. Similarly, the establishment of W3C, and the decision to base it in three locations, in the US, in Europe (Griset and Schafer, 2011) and finally at Keio in Japan, further sustains this argument – this capacity of enrollment and translation that originated with Berners-Lee's newsgroups announcement of WWW in 1991.

Other examples in Web history, on their hand, provide us with the needed opportunity to study the negotiations that took place within the W3C, but also among actors of a governance that was soon made broader, including, in particular, organized civil society. Janet Abbate (2012: 174-175) demonstrates this with clarity when she describes the controversy that took place at the end of the Nineties between the W3C and American activists for civil liberties, on the content filtering system called Platform for Internet Content Selection (PICS). On his end, Tim Berners-Lee argued that PICS was a mere tool that allowed users to choose their preferred content, and that Web developers were inspired by 'a vision of the way in which society needed to be improved [as] nowadays the social can evolve thanks to technology, while earlier on, the only way was to produce laws' (Harmon, 1998, quoted in Abbate, 2012). However, civil liberties activists were worried about the power of technologists, summarized under Lessig's formula 'Code is Law' in 1999, a year after the *New York Times* had dedicated time and space to PICS. As Abbate shows, the PICS system was never widely spread to the general public, and it was replaced ten years or so later by a new filtering system, this time at the service of advertisers seeking to target consumers. Yet, it serves as an illustration of Web governance as a complex

sociotechnical system of systems and it invites to analyse the plurality and ‘networkedness’ of hybrid devices and arrangements that populate, shape, and define the Web (Musiani, 2015).

Other work is reminiscent of this approach, whether it touches upon the general history of the Web and its governance or more precise aspects, for example on the relation we establish to information via search engines. In this regard, Badouard, Mabi and Sire (2014) note that a large majority of links is the prerogative of a small number of web sites, and the majority of sites is targeted by only a very small number of links. The authors conclude that this phenomenon implies a specific relation between users and information, which translates, in particular, into a daily imbalance in the agendas of online media, between a minority of over-exposed current news and a majority of confidential subjects. This approach invites historical studies of hyperlinks, such as those of Ian Milligan (2014) and Anne Helmond (2013) – and shows the interest of making these studies STS-informed and revealing of these imbalances and their evolutions.

Similarly, current research on Web tracking appears to fuel upon both media studies and STS, to look at Web history as an ongoing, technical and human negotiation and hybridization. Lerner et al. (2016) used the tool TrackingExcavator to conduct the most extensive longitudinal study of the third-party web tracking ecosystem to date, retrospectively from 1996 to present; they argue that

> understanding the trends in the web tracking ecosystem over time — provided for the first time at this scale by our work — is important to future discussions surrounding web

> tracking, both technical and political. Beyond web tracking, there are many questions about the history and evolution of the web (Lerner et al., 2016).

This study, as those previously mentioned, will certainly contribute to shed further light onto the performative function of Web arrangements and the invisibility, pervasiveness, and agency of infrastructure that shape the Web. The next section examines how these phenomena can be analyzed at the scale of a single web site, such as Wikipedia.

<h2> *From Wikipedia governance to algorithmic governmentality* <h2>

Pierre-Carl Langlais' work (2015) on the emergence of a Wikipedian normativity during the 2000s suggests governance issues can be understood and analyzed via STS tools. Langlais builds his work on Dominique Cardon and Julien Levrel (2009)'s framework analyzing 'participatory vigilance' – a notion developed by getting interested in the mechanisms of norm integration in the francophone Wikipedia. He remarks that until the end of 2003, the issue of references was not present in the foremost online encyclopedia. Indeed, the processes of modification and discussion were prevalent before the situation evolved in the mid-2000s. The 2004 recommendation 'cite your sources' is arguably born out of the important augmentation in readership, increasingly appearing tensions, and multiplied 'editing wars.' Analyzing the process through which a norm is imposed – which entails heavy discussions on the initial obligation it signifies – Langlais explains:

> In early 2007, the normative exigence of reference citation has reached its maturity […]

> Actually, all is left to do. Non-referenced contributions keep on coming […] Created in January 2007, the References Project initially gathers fifteen or so contributors. The emphasis is placed on the evangelization of the community […] Several practical tools are created to facilitate this evangelization process, including a number of banners signaling the lack or the necessity of a reference. Parallel to this external diffusion work, the References Project promoters develop an important clarification work. The first discussions center on suggestions of tools, and on proposals of rules to adopt. This strong coalescence of the technical sublayer and human organization appears as consubstantial of the wiki system (2015, our translation).

Prominent Internet historian Janet Abbate (2012: 171) argues that since its early stages, the network of networks has been about the merging of infrastructure and culture, which has constituted hybrid agencies, complex interactions between machine- and human-originated agencies in the creation of content and the elaboration of communication practices (*ibid*.:176). In this light, we can conceive of Wikipedia as a nexus between technical and human infrastructures, and examine the ways in which contributions, collective, individual behaviors and tools intersect, the different layers of human and technical agency at work. Indeed, increasingly often, robots are undertaking correction and signaling tasks, and the Recent Change patrol, looking for vandalism episodes, benefits from a number of automatic tools to supervise new modifications. As Dominique Cardon emphasizes: 'The epistemic rationale guiding a large majority of behaviors on Wikipedia must not be looked for in people, nor in the interface, but in the mutual adjustments allowing people to interact on the wiki' (2015, our translation).

The example of Wikipedia shows how digital environments raise multiple questions on how much autonomy users have, when faced with automatized decision-making. More broadly, architectures, programs, computer codes, algorithms, interfaces, recommendation systems, influence and co-shape the possible choices and decision-making capacities of users. In which ways do digital environments introduce visible or invisible elements that are susceptible to influence participation and decision? Indeed, Web history would greatly benefit from a diachronic study of environments, platforms and Web architectures exploring the evolutions that took place via a strong integration of hardware and software, of material and informational infrastructures, from the DIY of the Nineties to the development of Content Management Systems (see, in this volume, the 'Web in Context' chapter).

Code, software, bots, or hardware are no longer conceived as 'mere' technical devices but as actors themselves, and the result of human decisions at once – in short, as socio-technical constructions. In this view, an analytical examination of the place of robots, of interfaces, of algorithms or infrastructures (Musiani and Schafer, 2011 ; Star, 1999) is no longer an 'internalist' approach consisting in the exploration of 'black boxes' and an 'already-made' assessment of technology's capacity to constrain human decision. Instead, it becomes the analysis of a social, political, technical and economic co-construction, to be conducted all along the digital 'chain,' from developers to users, exploring technical architectures, upper and lower layers, design, applications, aggregation techniques and algorithms (Barocas, Hood and Ziewitz, 2013 ; Rieder, 2012), platforms (Gillespie, 2010).

In this regard, the notion of governmentality seems appropriate as the cornerstone of a theoretical framework that enables us to think the ways in which technical devices tend to co-structure the range of possible actions (Foucault, 2004). Within the more specific field of digital technologies, the notion of 'algorithmic governmentality' (Rouvroy and Berns, 2013) invites us to think how the digital 'makes' Internet users do things, and simultaneously, highlights its empowering dimension. In digital environments, different possibilities and multiple constraints merge and simultaneously express themselves in the development of action (Badouard et al., 2016). This fusion of what is possible and what constrains can also be found in the constant negotiations taking place in the field of Web archiving and, in the historian's eyes, introduce further arenas of 'mediation' within the Web of the past.

Web archiving as a microcosm of Internet governance

In 1980, Langdon Winner' seminal paper asked: 'Do artefacts have politics?' By 'politics,' Winner meant the 'arrangements of power and authority in human associations as well as the activities that take place within those arrangements' (Winner, 1980: 123). Applying this hypothesis to the study of Web archiving means to study how its distributed, diffused and technology-embedded nature (DeNardis, 2014) 'can embody specific forms of power and authority.' Observing infrastructures, Web archives design and their stakeholders 'coming together' entails looking into the scripts (Akrich, 1992) that perform role-sharing, the distribution

of competencies and some delegation of rule enforcement to algorithms and automated devices. As noted by Star (1999: 337-339): '[…] Study an information system and neglect its standards, wires, and settings, and you miss equally essential aspects of aesthetics, justice, and change.'

This 'relational' approach entails important changes in methods, as STS-informed fieldwork can go as far as including the arenas where the shaping of infrastructures and architectures are observed, deconstructed, reconstructed. Arenas where political decisions – explicitly so, or *de facto* – are taken concerning the code, the technical norms, the 'tinkering' and reconfigurations of technical objects (Star and Bowker, 2006: 151-152). In recent work (Schafer, Musiani and Borelli, 2016) we have set out to apply this perspective to the study of Web archiving, thus seeking to respond to Tim Hitchcock's interrogation:

> Where I end up is seriously jealous of the possibilities; and seriously wondering what the 'object of study' might be. In the nature of an archive, the UK Web Archive imagines itself as an 'object of study'; created in the service of an imaginary scholar. The question it raises is how do we turn something we really can't understand, cannot really capture as an object of study, to serious purpose? How do we think at one and the same time of the web as alive and dead, as code, text, and image – all in dynamic conversation one with the other. And even if we can hold all that at once, what is it we are asking? (Hitchcock, 2015).

By opening the black boxes of Web archiving (Musiani and Schafer, 2015) and by observing the

processes through which the Web of the past is ‘negotiated’ in several arenas of formal and informal governance today (Schafer et al., 2016), we have been able to demonstrate how Web archiving, as several other arenas in the past and the current Internet, relies upon a multi-stakeholder model of governance.

Indeed, the dialectic between different practices and sources of normativity – concurring or complementary – that can be found in Internet governance, may as well be found in Web archiving. The initial ‘anarchistic’ and flamboyant elements of the early Internet, for example, meet their match in the Archive Team’s ironic motto (‘We are going to rescue your shit!’), which has indeed opened up the way to some iconic rescues, such as Geocities’ from the shutdown by Yahoo!. Twitter and Facebook’s collection and capture of private data for archiving purposes is a testament to the component of Web archiving governance that is dependent upon the role of the private sector. National and international institutions occupy a central role, as illustrated by projects such as the French legal deposit and by entities such as the UNESCO chart on Digital heritage in 2003, the Internet Archive, the International Internet Preservation Consortium (IIPC) – with nuances ranging from the ‘international’ as the sum of national initiatives, to the ‘transnational’ approaches. Finally, the role of standardization bodies and technical discussions that occupy such a prominent place in Internet governance, like W3C and the IETF, can also be found in Web archiving with the IIPC meetings.

We have also showed how the notion of co-construction has found its way into Web archiving, where the main categories of Internet governance actors may be found – as well as their tensions.

It is the case, for example, of controversies between the common good and proprietary formats, and between different imaginaries of the Internet and the Web. In this regard, the missions established by, or delegated to, Web archiving organizations are interesting to observe, as well as the geopolitical and political tensions that contribute to shape and reshape them. Brewster Kahle's September 2014 and November 2016 appeals, respectively, show well how a reflection on the perimeter and mission of his project took place both when he raised public attention to China's blocking of the Internet Archive:

> China started blocking the Internet Archive again a couple of months ago, we believe, because they do not like our open access policies. In this way, we have started to understand the power in the hands of the Internet service providers. Let's keep our access to Internet sites 'Neutral' and not at the discretion of companies and governments (Kahle, 2014).

And when he appealed for funding to create a complete copy of the Archive's digital collections in Canada after the November 2016 elections in the United States:

> We are building the Internet Archive of Canada because, to quote our friends at LOCKSS, 'lots of copies keep stuff safe.' […] On November 9th in America, we woke up to a new administration promising radical change. […] It means preparing for a Web that may face greater restrictions. (Kahle, 2016)

As shown in Schafer, Musiani and Borelli (2016), Web archiving reactivates the same

polarizations, negotiations and dynamics between actors which had emerged at the time of Internet governance's birth – and it mirrors the fact that the present-day digital world is still developing unevenly.

<h1> **Conclusion** <h1>

This chapter has made an argument for – and illustrated by means of several examples – the suitability and usefulness of an STS-informed perspective on the history of the Web and Web archives. We have looked back to the first 'encounters' between STS and ICTs, then with the Internet in particular, and then with other disciplines that have sought to investigate the 'media' potential of such tools, the chapter has then come to examine how STS concepts, in particular that of boundary object in its multiple facets, may be of use in shedding light on Web history and, in particular, on its governance.

Indeed, as the second part of this chapter has shown, 'tackling the macro questions of politics and power related to IG requires unpacking the micro practices of governance as mechanisms of distributed, semi-formal or reflexive coordination, private ordering, and use of internet resources' (Epstein et al., 2016). STS can shed light on how, in the wide and vast march of History producing seemingly stable arrangements, small 'histories' of taken for granted, mundane activities of design and use contribute to *doing and making* the Web and its governance.

Incorporating into the analysis of Web history(ies) the intertwining of technical and political governance, the ever-changing games of alliances and power balances between very different actors, the visions, imaginaries and social worlds they each bring to the table, the agency of non-human actors and infrastructures as loci of mediation… these STS sensibilities enable us to connect the micro actions of individuals and the affordance of particular technical artifacts with emergent attributes of large, complex systems (*ibid.*, 2016). As such, they add another layer of understanding and appreciation of how the Web of our (recent) past was negotiated – and still is.

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