

The Soft Megamachine:  
Lewis Mumford's Metaphor of Technological Society and  
Implications for (participatory) Technology Assessment

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## ABSTRACT

This dissertation explores the megamachine, a prominent metaphor in American humanist and philosopher of technology, Lewis Mumford's *Myth of the Machine* series. The term refers critically to dynamic, regimented human capacities that drive scientific and technical innovation in society. Mumford's view of the nature of collectives focuses on qualities and patterns that emerge from the behavior of groups, societies, systems, and ecologies. It is my aim to reenergize key concepts about collective capacities drawn from Lewis Mumford's critique of historical and modern sociotechnical arrangements. I investigate the possibility of accessing those capacities through improved design for Technology Assessment (TA), formal practices that engage experts and lay citizens in the evaluation of complex scientific and technical issues.

I analyze the components of Mumford's megamachine and align key concerns in two pivotal works that characterize the impact of collective capacities on society: Bruno Latour's *Pasteurization of France* (1988) and Elias Canetti's *Crowds and Power* (1962). As I create a model of collective capacities in the sociotechnical according to the parameters of Mumford's megamachine, I rehabilitate two established ideas about the behavior of crowds and about the undue influence of technological systems on human behavior. I depart from Mumford's tactics and those of Canetti and Latour and propose a novel focus for STS on "sociotechnical crowds" as a meaningful unit of social measure. I make clear that Mumford's critique of the sociotechnical status quo still informs the conditions for innovation today.

Using mixed mode qualitative methods in two types of empirical field studies, I then investigate how a focus on the characteristics and components of collective human capacities in sociotechnical systems can affect the design and performance of TA. I propose a new model of TA, Emergent Technology Assessment (ETA), which includes greater public participation and recognizes the interrelationship among experience, affect and the material in mediating the innovation process. The resulting model — the “soft” megamachine —introduces new strategies to build capacity for responsible innovation in society.

## DEDICATION

For my family.

Steve, the speculative realist.

My father, the scientist.

My brother, the engineer.

& my mother, who said I could be something that does not exist yet.

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## PREFACE

His plan called for total exposure – Wise up all the marks everywhere.  
Show them the rigged wheel – Storm the Reality Studio and retake the universe.

-William Burroughs in  
*The Soft Machine* p151

Today in America and in many parts of the world we find ourselves in environments shot through with technologies of all descriptions. From the toaster, to the road connecting each driveway, to wire mazes snaking unseen through walls to bring us the Internet, to the image of city lights across the globe from a NASA satellite, we are permeated by technology. Science and Technology Studies scholars remind us that we live with the systems today that we, through a series of collective and individual choices, have wrought. However, the closest that most reading these words come to choosing one technology over another is purchasing and using consumer goods or (less directly) by paying taxes. Only a fraction of us work for the research labs that patent new discoveries or the corporations that innovate, design, and build the systems we use. Few research agendas or technology development paths become the direct subject of public political debate. The process of building technological systems is seldom politicized and we often “choose” by accepting the default of what is available to us (Brown 2009). Save for some recent public kerfuffles over Genetically Modified (GMO) foods and Bovine spongiform encephalopathy (BSE), or mad cow disease in Europe, if truth be told, most of us hardly notice the accretion of technologies in our lives. We do not note their propensity to multiply, interlock, and propagate a kind of internal logic that has us all driving on the

right side of the road, updating our software and restarting, waiting for traffic lights to change, and going about our business as drones attack strategic targets in Afghanistan.

Technological systems compel us to follow their lead in myriad ways. The invented fabric of society exerts a mundane but insistent control over our lives, making us comply, behave, obey in a way we don't normally think to question. Technology critic Langdon Winner (1986) writes that "technology has changed the exercise of power," asserting that artifacts and systems themselves are a kind of legislation. Paul Verbeek (2011) covers similar territory in the recent text *Moralizing Technology*. Technical infrastructures edify social and political choices and continue to influence us long after the designers are gone. Despite the social constructivist understanding that somewhere out there people are busy negotiating our technological reality, pervasive technological systems like the ones we live in today can still seem to take on a life of their own. In this view, the machines drive us. In Winner's words, the maxim "what man has wrought he can also change" begins to seem scandalous (1978, 314).

The title of this dissertation combines Lewis Mumford's idea of the megamachine with an allusion to the pulp novella by William S. Burroughs, *The Soft Machine* (1966). I will discuss the megamachine and what I mean by the soft megamachine at length in the pages that follow. I begin by borrowing the "soft machine" from Burroughs to stand in for a concern about where the individual body is in all this verbiage about sociotechnical systems. Burroughs's "soft machine" is important because it initiates the present inquiry into collective capacities, behavior and social psychology with a reminder of the intimate connection between technology and the body. For Burroughs, at the time of writing *The*

*Soft Machine*, this connection is quite literal. His ministrations to his own body involved routine doses of heroin. If we see *The Soft Machine* as autobiographical, it is an acknowledgment that the body still runs, but runs differently. The introduction of a chemical that allows the junkie author to tread the same streets as everyone else, but to do so in a way that is emphatically different and to express that experience in this novel. The *Soft Machine*'s radical text is then an artifact of an addicted homosexual writer living out and satirizing for his readership the rancorous relationship between the body and mechanized society. The book's circuitous narrative, crafted using a cut-up technique, tells the story of an agent who uses the power of "UT", or undifferentiated tissue, to change bodies or to alter his own. With the aid of a doctor who conditions the agent's body for time travel and for metamorphosis, the protagonist finds himself amidst a band of Mayan priests who compel their laborers to cultivate maize with mind control messages based on the Mayan calendar. The agent liberates the slaves and destroys the technocracy of the priests by reprogramming the messages to read: "burn the books, kill the priests" (Burroughs 1966, 93).

Burroughs' story of smack smacks of *bildungsroman*: in literature, a novel about the moral and psychological growth of the main character. Applied quite narrowly by critics of the German novel to include only a few 18<sup>th</sup> century texts, outside those circles it is a term that has come to describe a whole genre of coming of age narratives across national literatures and popular media. One literary scholar claims the *bildungsroman* may be the "symbolic form" of modernity itself (Moretti 1987). In this sense, *The Soft Machine* is a science fiction *bildung*, a polysemic term that can mean 'formation,

constitution, organization, and education' in a process of both personal and cultural maturation (Redfield 1996, 49). Burroughs' cut-up technique yields an expression of the disarray that ensues when the agent attempts to cope with a sociotechnical environment that stifles a free range of motion, thought, and both individual and civic discourse. The agent's journey to metamorphose as a means to liberate the Mayan slaves represents a version of the change this character experiences through an anti-hero's journey.

Burroughs lives and writes about a condition later captured in Donna Haraway's (1991) depiction of cyborgs. Chemical technologies, like parasites, are inside the author and his incomprehensible and lewd prose is the evidence of this symbiotic hybrid state with technology. In effect Burroughs lays bare the contemporary sociotechnical landscape and describes the attenuated process of osmosis that a junkie experiences to balance internal self and external technical control in the modern world. Science and Technology Studies readers may think that I am alluding to the literature of human enhancement and transhumanism, wherein humans design and appropriate technologies based on their needs, desires and fantasies to become different beings. While I will treat these themes, I want to suggest that the work of critical technology studies is to regard technology as an important influencing variable among others that shape collective human capacities as a dependent variable. In other words, collective capacities of various sorts are the results of both intentional and unintentional encounters with material technologies.

Burroughs treats chemical addiction as a virus that "erodes human subjectivity" (Melley 2002, 42). Effectively, drugs become characters in their own right and attack the autonomy of the conventional sense of the individual. In *The Soft Machine* and his other

novels, Burroughs represents the individual as a “total addict” incapable of a personhood that can act rationally apart from a network of human and nonhuman influences (2002, 42). What is more, the addict is terrorized by these influences and their constant *commands*, which the addict experiences as expressions of repressive power and which he also absorbs into himself. I explore the implications of commands in more depth later in chapter two in a discussion of the nature of crowds in Elias Canetti’s *Crowds and Power*. Burroughs’ protagonists are at effect of technologies that are at once sophisticated and inherently biological. Burroughs provides clues in this difficult-to-decipher work about the casualties of a different kind of sociotechnical change, at once more subtle, but perhaps closer to us than the dramatic arc of the industrial revolution and the grinding spectacle of world wars and atrocities faced by Lewis Mumford and Elias Canetti. Both authors sought to explain how mass killing becomes routinized in bureaucracy.<sup>1</sup> In Burroughs, there is a resignation – akin to a determinist view of sociotechnical arrangements -- that foregrounds the addiction and mania of an individual operating without agency. It is precisely because of the presence, up-front or latent, of the concern that technologies take on a life of their own apart from human intervention, that technology assessment (TA), formal practices that engage experts and sometimes lay citizens in the evaluation of issues associated with complex scientific and technical issues, exists in an array of forms: as an idea and as an exercise. Later in this work, in chapter three, we will return to the concept of *bildungsroman* and use it to frame the concept of forms of technology assessment that invite broader citizen participation as an

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<sup>1</sup> In *Pentagon of Power*, Mumford refers to those who execute out the most stringent aims of the megamachine as Eichmanns, alluding to Adolph Eichmann, an architect of the holocaust .

experiential process of civic rather than technological development. As we shall see, *bildung*, or development through collective experience, is at the heart of STS ideals about the benefits of involving citizens in the evaluation of different scientific and technical futures.

For me, this dissertation's reference to Burroughs' cult novel is meant to be a mnemonic to remind this author that technology assessment is a full-body experience. To track down what drives innovation and our assessment of it, one must remember the importance of human parts. Early exploratory research for this dissertation began with a concern for individual agency in the face of large technological systems. This early concern gave way subsequently to an all out exploration of the crowd as a social unit. This is precisely what Lewis Mumford who has thoroughly explored the collective interactions of human, material and natural processes would have us do. The reader may think I refer here to the extensive work done by STS social constructivists in this regard; those who have shown that behind each technological advance are a horde of people making decisions and that agency can be properly pinned down. Social constructivists try to recover the sense that control is possible. I do so in part, but I want to challenge us to imagine that, whether consciously or not, we have designed processes for TA based on a constructivist model of how people make technologies. TA and technology governance based on social constructivist ideas that affirm the possibility of individual choice and control are the interventions we have as a result. These processes are, for their part, culpable for the sociotechnical relationships we have today. While some of these conditions are success stories, others are malignancies, fraught with unforeseen outcomes



of scientific and technological risks taken under the moniker of innovation. The megamachine is not merely an early twentieth century dynamic between industrial workers and their factory conditions that dissipated when the air of cities cleared of the soot that belched from coal fired furnaces. We are still living, perhaps more than ever, in Mumford's megamachine, and with its mounting consequences. Mumford's metaphor shares characteristics with the concept of the anthropocene, referring to the evidence and extent of human activities that have had impact on global ecosystems to produce what many believe are destabilizing environmental impacts. Current TA practice does not adequately account for the interdependent relationship between the body and technologies. An assessment process designed to take this relationship into account, as I will show, should free us to question together not only how we should make things and who or what will win and lose in the process, but also to evaluate and alter the nature of innovation itself.

## Chapter 1

### INTRODUCTION

Science and Technology Studies (STS) scholars are not natural biographers of individuals; more often, our allegiance lies with groups and their dynamics. We interrogate the influence of multiple factors. We strain to make out the imprint of those factors in the blanched and shifting limestone of structures, both the brick and mortar sorts and as well as the epistemic and ephemeral kinds. These dynamics (we assert) shape society. In other words, STS scholars tend to side with the crowd. We debate what is in and what is outside of it, and what ideas and structures give it coherence from moment to moment. When technology is in the crosshairs of our analyses, we call this *mélange* of things and thoughts that make up the modern crowd “sociotechnical,” referring to the interaction of people, ideas and institutions with material affordances that constitute human action in the world.

Over the next pages I will introduce you to an idea that diagnoses the particular relationship between societies and their machines that gives us the sort of scientific and technological innovation we experience today: the megamachine. I will show that it is a foundational concept in STS. I will introduce the megamachine and my interpretation of it as a mechanism to direct our attention to the nature of collective human capacities that bring about the contemporary conditions that define today’s innovation. My aim is to get to a clearer definition of the nature of collective human capacities as these relate to innovation in the material world.

This dissertation grounds its inquiry in the work of an influential midcentury public intellectual, urban and architecture critic and theorist of technology, Lewis Mumford. The megamachine is a guiding metaphor that circumscribed Mumford's understanding of how technology has been produced throughout history and how it is likely to come into being in the future. I suggest that Mumford's work has established the context for "the sociotechnical" in STS. In this chapter, I review how technology studies arrives at a similar vision of the human and technology relationship through a path that begins with the examination of great scientists and engineers and ends up siding with "the crowd." By "crowd" I mean that the collective actions of many people whose names are unknown to us and who rarely step into the spotlight are the true architects of our social and technical realities. I then introduce a novel definition of "the sociotechnical crowd" that centers on Mumford's emphasis on the "human parts" technology, collective capacities of labor and other aggregate phenomena that make innovation possible. Notably, my definition of the sociotechnical crowd allows for the persistent presence and influence of material things and systems as drivers in the sociotechnical.

Lewis Mumford is a bona fide participant in political and social life, modeling public intellectualism in a form that may no longer exist. He was an unapologetic non-specialist who demonstrated an unfettered propensity to borrow and fuse together the ideas of other scholars, pundits, and politicians. In a review of Mumford's influence on social theory, Rochberg-Halton suggests that the work was largely unrecognized by the disciplinary social sciences because he pursued his subject matter with passionate reason, rather than the "value free" inquiry touted by the sociologists of his time and possessed a

command of the English language that put him outside the purview of academic “sociologese” (1990, 127). His work is an emphatic reminder that scientific and technical concerns are not just for the technocrats and statisticians, but also for artists and educators, humanists and urban planners, and the surfers of popular and electronic media. Indeed, if Mumford had not existed, we scholars of STS would have to invent him.

Mumford critiques a particular sociotechnical arrangement that depends upon inanimate, human, and framing epistemic arrangements that create the current conditions for scientific and technical innovations. Mumford believed these sociotechnical conditions block out the possibility of cultivating a sort of innovation that centers on human creativity. The megamachine thus bends human creativity towards very particular and unsustainable outcomes at the expense of other possible modes of creativity.

In order to realize the extent of Mumford’s critique and to show that these same sociotechnical conditions persist today, I introduce parameters offered by other social theorists and STS scholars that help amplify the aspects of the megamachine that destabilize established ideas about how components in a sociotechnical system behave in the aggregate. I introduce this additional scholarship in order to reexamine the megamachine and revive its critique by showing that we are caught up in a system that restricts our ability to move beyond it. I then provide an outline of the subsequent chapters and take a step back to introduce why a fresh look at the megamachine is a vital move that can aid us in evaluating large scale systemic risks. I introduce the concept of slow violence, referring to delayed destruction that happens gradually over time and space that is rarely labeled as violence at all. In order to recover key aspects of what

Mumford meant by invoking his megamachine metaphor, we must take a critical stance towards our routine sociotechnical relationships and recognize the ones that implicate us in slow violence.

The megamachine refers critically to dynamic, regimented human capacities that drive innovation. A powerful combination of routines in labor; specialization of interests and training; management and governance by institutions; categories and hierarchies of knowledge; and the instantiations of these social forces in material form through technologies, systems, and goods set the conditions for the megamachine. Mumford cites iconic examples of this machine at work such as the tremendous labor force required to erect the pyramids in Egypt at a time with modern engineering was not available to aid the process. Mumford identifies five qualities in the megamachine: its physiology of human parts; its bureaucratic structure; its objective organization of knowledge, including its preference for scientific rationality; and its orientation toward power and processes of transformation. Taken together, this metaphor is the progenitor of the now well-established concept of “the sociotechnical,” a term introduced by Thomas Park Hughes (1993, 140; Latour 1999, 207) in a text on electrification that has become central to analysis in STS. Mumford wrote at length about how technology extends human perceptions, dreams and experiments that in turn changes the nature and scope of our conscious and unconscious presence on the Earth.

While Thomas Hughes, the historian, admired Mumford’s sweeping treatment of technology in its long evolution over human history, he contested the technological determinism implied by this metaphor of the megamachine, dismissing it as primitive

(Bruno Latour 1999, 207). Yet this critique may be misguided. In giving form to the megamachine as a societal condition where things, ideas and technologies converge, Mumford also identifies **the whole** as a crucial level of analysis for examining technological impacts (Casillo 1992, 92). From this vantage point, instead of finding that technological advances drive history, Mumford insists that we focus on collective human capacities of mind and creativity that exist only residually in technological artifacts.

By human capacities I mean to consider the totality of forces that collectives can exert in concert with their environments and the material conditions in them. While a particular capacity might be held or carried out by an individual, following Mumford's lead I assert that the capacity of the collective, or what I am referring to as "the crowd," has a unique impact on environments that amount to more than an accretion of individual efforts. There are qualities unique to the collective that have ramifications for our understanding of the effects of innovation. This view of the nature of collectives and their actions turns away from the description of individual agency, or rational actors, and instead focuses on qualities and patterns that emerge from the behavior of groups, societies, systems, and ecologies.

Many metaphors in social theory have sought to capture the energy of the crowd as an entity, describing the invisible hand of capital (Smith 1904), the power of the state as Leviathan (Hobbes 2003), the influence of networks (Castells 2000), macrocognition (Huebner 2014), and even the concept of the singularity, a condition when artificial intelligence, human biological enhancement, or brain-computer interfaces will converge to produce a superintelligence (Kurzweil 2005). I invoke the significance of the crowd as

a sociotechnical entity, containing a mix people and their technologies and the natural world as a means to understand more clearly Mumford's critical stance on the systemic relationships that produce the contemporary megamachine.

Social constructivist theory in STS developed in part to critique technological determinism, the sense that technology is driving history, and to give us back the power to change our technological environments. Merritt Roe Smith and Leo Marx introduce two approaches to technological determinism: "hard" and "soft". In the case of hard determinism, material technologies themselves influence events and dictate the sequence of steps that lead to the next novel invention, independent of social constraints. Soft determinism focuses on the influence of technological change as supported by social political and cultural knowledge and institutions (Smith and Marx 1994). The dominant critique of technological determinism is that it renders technology opaque and outside of political control (Wyatt 2013, 463). As Mumford's megamachine does, I also wish to take into account the possibility of the influence of technological systems on collective capacities at meta, or aggregate, levels as I formulate this alternative definition of the sociotechnical crowd. I take determinism seriously once more as a means to account for the ontological power of material existence and the questions it raises about what kinds of political control are needed, what metrics and indicators can show change, and what types of intervention matter.

Social construction of technology refers to "a theory about how a variety of social factors and forces shape technological development, technological change, and the meanings associated with technology" (Johnson 2005, 1791). A foundational text arguing

for a new method to analyze the “Social Construction of Technology”, or SCOT, shows us how the bicycles we pedal today evolved from alternative forms, “boneshakers” and “penny farthings” (Pinch and Bijker 1987). Similarly, Cowan (1983) defines an inflection point when housewives remodel their kitchens. She illustrates change in the American home through the introduction of small appliances and home improvement. Studies of artifacts allow for analytic precision: a parsimony that renders it possible to comprehend how the decisions and deeds of multiple actors, organizations, and institutions brought a particular apparatus into being.

Other researchers have described the development of large technological systems or regimes. These studies step back from the specificity tied to describing the origin of artifacts. These authors consider how technological paradigms: trajectories and selection environments emerge in social activity. Looking at the development of the commercial dye industry, Hughes pitches a framework that treads similar ground, but confronts the deterministic view of technical change. In this light, invention happens as the collective actions of technical practitioners employ heuristics to produce novel dye colors for a growing market (van den Belt and Rip 1987). Hughes (1987) focuses on how systems evolve. Choosing to describe the history of electric light and power between 1870 and 1940, Hughes observes issues of technological determinism and dynamism in open and closed systems. In a closed system, there is little interaction with the environment outside the system, so bureaucracy and routine govern how it works. Using this lens, systems are both socially constructed and society shaping. For Hughes, system maturity, size and degree of autonomy are harbingers of how much freedom people have within it.



Conditions that result in stabilization and closure are key kinds of interactions discussed by STS scholars who explore the stages of development and evolution of technologies – the first set of “instances” discussed above. These two concepts are bound together in the end stages of the maturation of a given technological artifact or system. Stabilization occurs when social concerns around a particular technology are sufficiently diffused among stakeholder groups. Then controversy between these groups ceases. This last action is known as closure (Law 1987, 111). This interaction describes both how the form of a particular artifact becomes commonplace, and it also refers to a normalization of the attitudes and actions of different interest groups involved in shaping this machine. Social issues align enough that controversy over the technology subsides. These two concepts are useful for highlighting the influence of actors in the early and middle stages in the life of an artifact or system.

In explorations of development, evolution and invention, entrepreneur scientists and engineers drive design and implementation, following the “great men” model inherited from conventions in historical bibliography (van den Belt and Rip 1987; Bijker et al. 1987; Law 1987; Callon 1987; Constant 1987; Winner 1986; Hughes 1987). Law, in his introduction to an edited volume concerned with technology and power dynamics, provokes with the statement that STS “finds heroes to be more interesting than ordinary folk” (Law 1991, 13). It is no wonder that STS scholars interested in technology at first spent significant time following inventors. They originate artifacts and systems – the place where theorists interested in finding “loose threads” in the web binding society and

technology together can first begin to look for evidence of the people behind the machines.

Roles for actors who are not scientists and engineers emerge in studies of consumers and users (Schwartz Cowan 1987; Bijker et al. 1987; Jasanoff 2004; Oudshoorn and Pinch 2003), patients using medical and reproductive technologies (Bodewitz, Buurma, and de Vries 1987; Cussins 1999; Thompson 2005; Franklin and Ragoné 1998), and the curious new human-machine entities: the cyborgs and the *Modest\_Witness* (Haraway 1991; Haraway 1997). A key place where these actors find themselves is not at the place of invention, but rather at a “consumption junction,” or “the place and time where at which the consumer makes choices between competing technologies” (Schwartz Cowan 1987, 263). The consumer gives us a view of how a socio-technical webs, or networks, look when we are already dangling in them.

Further, cultural theorists and historians have studied how technologies and the material impact identity. Hecht (1996) demonstrates how an ensemble of language, artifacts, gestures and practices formulate worker cultural identity in a French nuclear facility. Feminist scholars prepare us to shape shift in a non-naturalist mode among multiple social and technological memberships. Patients and medical professionals are linked inextricably with the technologies used to (alternatively) treat and objectify them. Actors are unable to reject particular technologies or interactions with systems (Thompson 2005, 180). Haraway (1991, 149) represents this in her vision of cyborgs: a transmogrification of human and machine that is both fact and fiction. Authors reveal this heterogeneous interaction through descriptions of female experience and, in the case of

Donna Haraway's *Modest\_Witness*, semantic notations associated with the volume's title (1997; Leigh Star 1991; Wajcman 1991). In contrast to the view of intentional and purposeful actors creating their technological environments, this approach focuses on interactions in the context of multiple identities. Haraway asserts that there should be "pleasure in the confusion of boundaries and (at the same time) responsibility in their creation" (1991, 150). Starr uses the idea to warn that claims of universality miss the fact that there are always misfits, actors who fall into a residual category, not yet targeted by MacDonaldis' marketing, not yet disenfranchised either, but those in the midst of transition or translation (Leigh Star 1991). In other words, the technology is us. People are implicated in technological change; here is no equipment to put back in the toolbox, yet like Burroughs' protagonist in *Soft Machine*, the human is transformed. Unlike entrepreneur scientists and engineers whose role in the invention of systems has been made clearer by STS scholars, these characters struggle to assign and also to establish their own responsibility for technological choice.

The interactions outlined so far are approaches for identifying the human hands that advance technologies into mature stages. Some theorists have examined knowledge production and the dynamics of lay and expert interactions in this process. Sociologists Gibbons et al (1994) describe "mode 2 knowledge" that is produced by multidisciplinary teams to tackle real-world problems. The concept is encapsulated by the term "co-production" which describes a systemic interrelationship between knowledge, social interactions and technologies (Jasanoff 2006).

Callon describes another daring interaction that also applies the concept of

simplification, even as it brings other new and unfamiliar elements under the analytic tent. Actor Network Theory, or ANT, (Latour 1992; Callon 1986; Callon 1987) is a methodology that places human and non-human actors on equal footing (Latour 2005). In this model, all potential stakeholders in an interaction become equal nodes in a network, each possessing knowledge or qualities with the potential to sway the endeavor's outcome. ANT focuses on four moments of translation that occur as humans, technologies, and objects in the environment engage: problematization, interessement, enrollment, and mobilization. Each translation illuminates how actor identities, actions within established boundaries, and specific choices determine the power dynamic and sociotechnical composition within the network. Simplification occurs when entities stand in for, or represent a cascade of others not currently active (Latour 1992, 96; Callon 1987). Callon introduces this new methodology in his examination of engineer "sociologists" at EDF and Renault who invent and attempt to predict and influence future markets for the electric car in France. He later uses it to introduce us to both human and natural actors working together to domesticate scallops in St. Brieuc bay to meet market demands (Callon 1986; Callon 1987). Latour uses ANT framing to assist us in deciphering how it is that artifacts stand in for silent actors and also perhaps why is difficult to recover the social contexts that produced mundane technologies such as door hinges and seatbelts (1992).

In the selection of STS scholarship considered here, each author casts a vote about how best to help us notice more about technologies and their creators by selecting topics or cases; characters that invent, make, use or otherwise encounter technologies. These

scholars also invent ways of describing the interactions between humans and the technological environment in terms of the formations of identity, culture, and history. Though the discourse is about a continuum of potential choices that leads us to the present, stories about systems help us to understand moments of closure where a particular technology or system becomes stable. Certain possibilities existed at a time in the past, and then technologies settled into a particular groove. This line of argument retains a kind of linearity that allows what is perhaps a false sense of tidiness about origins and reasons for existing technological regimes: a sense that we've got a handle on how we arrived at the status quo.

Lewis Mumford's criticism of technology is foundational to each of these approaches, treating artifacts, systems, the influence of time, and particular forms of knowledge as interdependent. Even given the proliferation of analyses of technology flowing from Mumford's work, I argue that aspects of Mumford's oeuvre remain unique and challenging for today's generation of thinkers. Mumford refers to machines as distinct from individual tools, meaning apparatus "developed out of a complex of non-organic agents for converting energy, for performing work, for enlarging the mechanical or sensory capacities of the human body, or for reducing to a measurable order and regularity the processes of life" (1963, 10). The interactions between machines and society together are "technology" or "technics." To settle on a working definition for technology here, I borrow from two critics of technology, Langdon Winner and Jacques Ellul. For Winner, technology is "the totality of means employed by a people to provide itself with the objects of material culture" (1978, 8). This conception builds upon Ellul's

(1964) reference to “la Technique,” or “the totality of methods rationally arrived at and having absolute efficiency (for a given stage of development) in every field of human activity”. Mumford’s depictions of human and technical relationships evolved from what Smith and Marx (1994, xiii) have called a “soft determinism,” where technologies and the material defined at both the micro and the macro level define a social changes in human history, to his more interwoven and interdependent concept of the megamachine, “a system made up of interchangeable parts, inanimate and animate, human, mechanical, and institutional, centrally organized and controlled”(Hughes and Hughes 1990, 10). Mumford’s definition of technology is firmly rooted in a process of innovation that contains both human and material parts rather than a merely a product or artifact and epitomizes what many in STS now refer to as the “sociotechnical.”

My new analysis of Mumford’s work refocuses attention on the path of this evolution to show that the material retains a persistent and iterative influence on the sociotechnical and can be detected in the behavior of aggregates: what I am calling collective capacities or “crowds”. Collective capacities deployed differently than they are today could lead not only to innovative material goods and technologies, but would cultivate and deepen human and material relationships to support the evolution of creative mind as a central concern.

The first part of this project is structured around a single research question that engages the literatures of STS and critical technology studies. I ask: what are collective capacities that Mumford represents in his concept of the megamachine and how do they work in sociotechnical systems?

For a theorist who is also a student of policy, there is also a question about practice that follows from the first question: that is, how can a focus on the characteristics and components of collective human capacities in sociotechnical systems, rather than on the social dimensions of a particular technological trajectory, impact the design and performance of technology assessment (TA)? Participatory technology assessment (pTA) is a collection of (typically formal) strategies for engaging citizens more directly in registering preferences for directions and applications for technological development. pTA as a practice is embedded in an intellectual concern discussed by science and technology studies scholars about how much the public should - or could - be involved in technical development and decision-making. This broader concern is known as public participation or public engagement. I critique formal TA using the theoretical construct of Mumford's megamachine as my lens.

Taken together, this dissertation reenergizes key concepts about the collective capacities of sociotechnical crowds, collectives of both human and material actors, drawn from Lewis Mumford's critique of our historical and contemporary sociotechnical arrangement. These concepts can be applied to a new model for governing innovation systems. I argue that existing theory of the social construction of technologies (SCOT) and contemporary planning, policy and design practice do not account for several important characteristics about the behavior of collectives and the importance of materiality in the formation of sociotechnical realities that play out in the aggregate.

To bring this critique into sharp focus, I give substance to the idea of collective capacities in sociotechnical aggregates, examining both social theory of crowds and the

behavior of materials and the non-human as a part of those systems. As I create a model of collective capacities in the sociotechnical according to the parameters of Mumford's megamachine, I address and provide alternate interpretations of two established ideas about the behavior of crowds and about the undue influence of technological systems on human behavior. The first idea is the dominant notion that crowds are a harbinger of unfettered violence and need to be controlled. The second is an all but discredited idea of technological determinism, a theory that presumes that a society's technology drives the formation of its social structure and cultural values.

In Chapter Two I examine of the constellation of concerns associated with Mumford's definition of the megamachine, as outlined in the *Myth of the Machine* series this is "an invisible structure composed of living, but rigid, human parts, each assigned to his [sic] special office, role, and task, to make possible the immense work-output and grand designs of this collective organization." (1967, 1:189). Research along my question involves a close reading of Lewis Mumford's criticism of technology, including the *Myth of the Machine* series, representing his critical work on technology that defines a constellation of concerns around the concept of the megamachine. To contextualize this analysis and situate it in a tradition of STS theory, I examine two pivotal works that describe and characterize the impact of collective capacities on society and, in turn, socio-technical arrangements: Bruno Latour's *Pasteurization of France* (1988) and Elias Canetti's *Crowds and Power* (1962).

With the help of an Elias 's *Crowds and Power*, I establish crowds as a distinct unit of social analysis and demonstrate that crowds have a multiplicity of behaviors. I



argue, with Mumford, that the crowd behaviors, or collective capacities, that give us the terms for scientific and technological innovation under the megamachine marginalize other ways that crowds, as a metaphor for an innovating sociotechnical society, might behave.

Then, with the aid of Bruno Latour's philosophy of irreductions outlined in *Pastuerization of France*, I revisit the soft determinism reflected in Mumford's earliest work in *Technics and Civilization* where materials impact behavior and social psychology as they are taken up in different stages of innovation, what Mumford calls technological complexes, to consider the influence of non-human and material factors in the sociotechnical. Whereas Latour (1993) seeks to break down what he sees as the modernist impulse to create a "pure" duality between humans and nature using Actor Network Theory (ANT) as a methodology for understanding how the sociotechnical is formed, I focus in on the influence of non-human aggregates. I argue that in the aggregate non-human "crowds" shore up influence that perpetuates sociotechnical arrangements that constitute the megamachine. What I argue runs counter to Latour's assertion that no actors in a network retain what Heidegger (1977) calls a "standing reserve" or "energy available for any use to which humans choose to put it." Non-human aggregates persist. Persistence is a quality that remains influential in Mumford's megamachine even as he shows the influence of human and social factors on the formation of the conditions and terms for innovation/progress. In Latour's interest in forwarding a model of *irreductions* among the human and non-human he makes a key observation that dominates the field of STS and the descriptions of the sociotechnical today, however this emphasis has further

marginalized the sort of critique that Mumford wished to make and that I urge is constructive for STS today.

By making alternate interpretations of the ideas about the behavior of crowds and about the undue influence of technological systems on human behavior, I make clear Mumford's critique of the sociotechnical status quo that still informs the conditions for innovation today. I depart from Mumford's tactics and those of Canetti and Latour and distinguish my analysis by proposing a novel focus for STS on "sociotechnical crowds" as a meaningful unit of social measure and on crowd behaviors as a function of interaction with the material as significant beyond the simple equation of crowd power as the sum of individual wills standing together. I reconnect an understanding that crowds have many capabilities to the idea that the materials of production themselves fix sociotechnical relationships in my definition of the sociotechnical crowd.

In the second part of this dissertation I will use this new understanding of collective capacities and of the not insignificant influence of materiality to examine several experiments in TA that include public participation. In Chapter Three I examine three experimental pTA processes for potential strategies for engaging publics more fruitfully based on this new understanding of the crowd. I propose ways of feeding insights from those reflections back into design practices for pTA. I next demonstrate a gap between how STS theory conceptualizes human influence on innovation processes and the design of contemporary TA practice. I argue that affective, material, and experiential knowledge are not commonly incorporated into deliberative forums, and the opportunities for steering innovation, developing governance mechanisms and taking

advantage of the social resilience that can be generated by emergent practices are not fully realized.

Lastly, I confront the issue of the scale of interventions needed to make significant changes to the terms that give us the contemporary megamachine. Ultimately small-scale mini publics alone are probably not sufficient. Brian Wynne (2006) charges that public engagement itself can enroll people into particular sociotechnical relationships. In Chapter Four, I analyze empirical data about the Transition Initiative, a new social movement that is attempting to reorient social processes around different collective capacities. I use this case to reflect on whether “the crowd” can “back slowly away” (as Mumford recommends at the end of *Pentagon of Power*) from the excesses of technological innovation on its own initiative. I call this *Emergent Technology Assessment (ETA)*, or the possibility of new sociotechnical relationships through a process of collective social change, rather than assessment targeting specific technologies or systems.

In the final Chapter Five, I outline a new framework, the “soft megamachine,” that derives its name from Mumford’s original metaphor to refocus on the areas of concern outlined in his original metaphor. I suggest ameliorations in these areas through processes that redirect collective capacities towards alternative goals and outcomes. I return to and reinterpret Mumford five components of the megamachine: human parts, bureaucracy, organization of knowledge, power and transformation and situate these components under three areas of practical action: innovation, government to governance and emergence and convergence. The resulting model of a “soft” megamachine

foregrounds the critique of the current sociotechnical status quo in Mumford's original metaphor of the megamachine and suggests ways to alter the design and practice of TA and to understand contemporary visions of the network society. This dissertation therefore both advances theory and explores empirically the interrelationship of collective human capacities and occasions for intervening and introducing reflexivity into TA practice.

## **POWER, VIOLENCE AND TECHNOLOGY**

Mumford's work is created over five decades and holds a mirror to the monumental transition from twentieth to twenty first century techno-society. The need for another look at these ideas is rooted in concerns repeated by scholars of geopolitics and technology about power and agency as these ideas relate to democratic society. A revival of Mumford's idea and the concerns a writer and scholar of his time faced comes at the right moment to supply today's thinkers with an understudied interpretation of the nature of innovation, government interventions, and emergence in the world in which we live. Mumford would have us reflect seriously on the degree to which technologies and their systemic relationships perpetuate harmful sociotechnical arrangements and constrain creativity.

Unintended outcomes and magnified risk resulting from sociotechnical choices that accrete as the result of complexity in the aggregate cannot be fully accounted for using our current conceptual models of the social construction of technologies. Rob Nixon suggests that many geopolitical problems we now face can be seen as "slow

violence,” a “violence that occurs gradually and out of sight, a violence that is delayed destruction that is dispersed out across time and space, an attritional violence that is typically not viewed as violence at all” (2011, 2). Nixon associates this type of violence with ecological and social damages experienced by the poor and those in the global south.

The study of violence first surfaces in the work of Galtung in the context of “peace studies” in a piece written in 1969. This article identifies violence as a causal subject-object relationship as a means for talking about forms of violence not traditionally accounted for by this description; important among these is what this scholar names “structural violence.” For Galtung, structural violence occurs when there is no clear subject-object relationship, no personal drama that can be captured in language. There is no clear opportunity for the kind of politicization that is necessary to bring the condition to arbitration. Instead, violence without a clear subject/object relationship that separates a potentiality from the possibility for that potential to be actualized is structural, or built into the system (Galtung 1969, 171).

Though STS scholars do not use the term “slow violence,” some are attentive to this concern from different vantage points. Feminist STS scholars identify systemic injustices ranging from the intimate context of domestic conveniences to macro socioeconomic and ethical themes in global development (Cowan 1983; Sen 2006). Nussbaum (2000) argues that constitutional principles that take into account conditions of female oppression in different national contexts could make it possible to develop a

comparative measure of quality of life that focuses systematic attention towards the alleviation of suffering for women around the world. Concepts of structural violence emerge in the examination of global human development and resource management (Escobar 2012; Ferguson 1990; Khagram 2004) and can be inferred from discussions of complex systemic risk in texts like Langdon Winner's *Autonomous Technology* (1978) and Charles Perrow's *Normal Accidents* (1984). Others have emphasized the structural and semantic constraints present in categorization and classification in race relations under apartheid and in transnational definitions of the HIV/AIDS epidemic (Bowker and Star 1999; Karnik 2001). The concepts of structural and slow violence set the stage for this look back at Mumford's criticisms of technology against the concern about power and agency in global geopolitics.

Technological determinism is a largely discredited way of depicting the structural influence of technology. Since the 19<sup>th</sup> century, tracking the rise of the industrial revolution, philosophers and critics have ascribed a kind of inevitability to the material changes happening in society in the form of rapid and successive technological improvement (Smith 1994). Technology, with speed and force, pushes new material culture along (Ellul 1964; White 1962; Mumford 1970).

In looking at the trajectory of STS scholarship since the mid 70s, one discerns a distinct move away from a deterministic view of how technology impacts society and towards one that invites nuance and reflection upon the behavior, politics, and ingenuity of people constructing and maintaining machines. This has been one of the true hallmarks

of STS scholarship – to reveal the often-silent humans who are making things happen behind the curtain. Here are the scientists, inventors, users and resisters collectively maintaining the smoke and mirrors of a technological wizard of OZ.

There is at least one significant and under-examined work among this literature that lays out a case for why we might continue to be concerned about the phantasmagoria of OZ that there is more to consider than the mob behind the curtain twiddling knobs, making deals, and issuing commands. That work is Langdon Winner's *Autonomous Technology*. Winner's book revisits and provides a different interpretation of the central theme in an earlier work of technological criticism, Jacques Ellul's *The Technological Society*. Winner considers how it might be that technology has a force in the world that is greater than the sum of its human creator's wishes, efforts, collective plans and designed components. Explicitly, Winner makes claims about how artifacts embody politics and how those politics affect our lives in the absence of human actors (Winner 1978; Winner 1986). There are three ways Winner's "autonomous" technological systems present problems for the people who, ostensibly, operate them. These are: 1) accidents and malfunctions in systems that are unanticipated and whose causes are difficult to determine. These are Perrow's normal (atomic) accidents (1984); 2) "command and control" problems, where individuals or groups start up large-scale operations and then cannot control their direction or halt them; and 3) issues of responsibility – in complex interrelated activities involving human and non-human components, it is near impossible to identify a human culprit. These three issues bound the discussion of individual and collective freedoms in relation to technological systems.

Echoing Galtung's framing of structural violence, Winner demonstrates how technology can be a kind of legislation (Winner 1986). Winner, who is heavily influenced by Mumford's work on the relation between humans and technics, in effect allows us to consider the development of complex and interconnected sociotechnical systems as a kind of slow violence. If contemporary sociotechnical conditions perpetrate slow violence, then the question becomes how societies can fashion mechanisms for intervening into processes of innovation that create and perpetuate social, economic and ecological ills. This is the central normative concern of this dissertation. In order to determine an appropriate empirical design for inquiring into interventions like TA techniques and their connection to the public, we must first inquire into apt critical concepts for accounting for the sociotechnical contours of progress.

It is time to temper the analytic climate in technology studies that privileges the assumption of a human-constructed reality over one that takes seriously reference to the persistence of material things. Latour has given us way to account for the non-human in actor network analysis, but maintains it is a method rather than a theory of this relationship that accounts for the value of these relationships (Latour 2005). There is evidence of a shift in emphasis on the way that non-humans appear in technology studies signified by a renewed interest in things and in their typologies and how categorization informs the sociotechnical (Woolgar and Lezaun 2013). In a recent special issue of the *Social Studies of Science*, Woolgar and Lezan introduce the distinction between epistemological and ontological analysis. They state that the ontological approach "short-circuits the tendency to rephrase questions about the reality of multiple worlds as



questions about the multiple ways in which a singular world is represented, and in so doing stimulates an alertness towards forms of difference that cannot be reduced to a disparity of ‘worldviews’” (Woolgar and Lezaun 2013, 322). In other words, there is a move away from validating many realities to referencing and noticing the differences related to describing a single reality. This is not a move to force a single concept of the real. Instead it is evidence of a renewed interest in the persistence of the material. I will revisit this idea of persistence in my discussion of Mumford’s treatment of materials in industrial production and in Latour’s inclusion of the non-human as actors.

Scholars who have helped us understand the nature of slow violence contribute more to an understanding of how technological systems act on our lives. This is precisely because framing a particular set of sociotechnical relationships, as the cause of violence, is the precursor to identifying opportunities for interventions that can address this cause. Identifying a phenomenon as violent, even in the unfamiliar territory of the routine, the everyday, and the unpoliticised, enables further inquiry. Three concepts related to theories of power, violence and technology address a landscape of particular salience to this exploration into Mumford’s central metaphor – the megamachine.

It is my aim not only to reinvigorate the critical gaze Mumford meant in constructing the megamachine metaphor, but also to recontextualize it in the context of the slow violence that we face. Mumford, Canetti and to some degree Latour wrote in the shadow of two great world wars and mechanized, overt destruction on a global scale. The seeds of the types of risks that are appearing today were sown then. Though war and mass social agonies persist, we also must live with the violence that emerges from the

most mundane accretion of technologies in society such as the plastic gyre in the ocean and the accumulation of pharmaceuticals in our water supply, and the promise of new, well funded multi-sectorial techniques of manufacture that produce ubiquitous materials through nanotechnology and synthetic biology. A new look at the megamachine with a serious examination of what this arrangement of collective human capacities has wrought is the core of this work.

## Chapter 2

### THE MEGAMACHINE

#### **LEWIS MUMFORD, TECHNOLOGY ASSESSOR**

Why bring up Mumford now, nearly two decades after his death and while many new philosophers of technology forge ahead making sense of things in an era of technics that he was only just beginning to explore in the twilight of his career? Between the time of his birth in 1895 until his passing in 1990, Mumford was in the full sense of the word a technology assessor in a grand and public way. This man was an omnivorous critic who took care to unpack with impunity each subject he entertained. In 1929 Mumford edited the transcendentalist literary magazine, *the Dial*, which published the likes of Pound and Eliot. He explored the origin of utopias (1962), the writing of Herman Melville (1929), the literary contributions of the American Transcendentalists (1955), the history of the city (1961a), and the development of alternative forms of urban and suburban planning to launch what would become known as the garden cities movement (1968). In the 1930s, he wrote a regular column about architecture for the *New Yorker* magazine, making him one of the most widely read architectural critics of his time. His thirty books on literature, culture, architecture, urban planning, and technology amount to a grand narrative that digests the industrial revolution almost in its entirety. Though Mumford has written volumes on many topics, I focus here on his writings about technology: *The Myth of the Machine* (1970) series as well as the earliest treatise on this topic: *Technics and Civilization* (1934). This work is important to the development of Science and Technology Studies (STS) because in outlining the aspects of mechanization that shape

the interactions of people and technologies, Mumford establishes the context for “the sociotechnical” in STS, but with a critical eye. It is through this analysis of the megamachine that I arrive at the conviction that a fresh look at the sociotechnical is needed. An examination that takes collective capacities for innovation as a significant social entity, what I call “crowds”, and the influence of technologies and the material on these entities.

Through a close reading of Lewis Mumford’s critical work on technology. I define a constellation of concerns around his concept of the megamachine. I review key themes from the earliest work, *Technics and Civilization*, which evolve later into the larger vision of the megamachine: the technological complexes, the vexing constraints of mechanization and the rationalizing force of science, and finally, the pressure of the materials of production themselves on collectives. To contextualize this analysis and situate it in a tradition of STS theory, I introduce two additional pivotal works that treat the impact of collective capacities on society and, in turn, socio-technical arrangements: Elias Canetti’s *Crowds and Power (1962)* and Bruno Latour’s *Pasteurization of France (1988)*. I use literary analysis to illuminate themes in Mumford’s megamachine and amplify them through the writings of Bruno Latour and Elias Canetti. I will make out and elaborate on what Mumford means by collective capacities that drive material innovation by following the narratives and paths that others have wrought in myth, fiction, history, and STS theory. I then introduce the megamachine and its five qualities: its physiology of human parts; its bureaucratic structure; its objective organization of knowledge, including its preference for scientific rationality; and its orientation toward

power and processes of transformation. I match principles that define Latour's actants and networks and Canetti's crowds with each of these.

Through this matching, I create a model of collective capacities in the sociotechnical according to the parameters of Mumford's megamachine by rehabilitating two established ideas about the behavior of crowds and about the undue influence of technological systems on human behavior, also known as technological determinism. The first idea is the dominant notion in social theory that crowds are monolithic and a harbinger of violence that needs to be suppressed. The second is an all but discredited notion of technological determinism: a theory that presumes that a society's technology drives the formation of its social structure and cultural values. The resulting new understanding of crowds can provide a framework for the analysis of and design for TA practices to place the focus on emergent capabilities, what I will call "Emergent Technology Assessment" in Chapter Four. I undertake this synthesis to consider the question of how governance might work if sociotechnical crowds are important factors in the world.

## **THE TECHNOLOGICAL COMPLEXES**

For Mumford, the term machine stands in for the technological complex, distinct from the use of the term "tool", which refers to an individual instantiation of the human technology relationship (1963, 12). Scholars of STS have since used the terms 'sociotechnical systems' and 'technoscience' to represent a systemic interrelationship between human interactions, science, and technologies.

Like a catalog for a world exposition, *Technics and Civilization* is peppered with photographs covering the development of technics and culture over last thousand years. This volume cleaves history into three overlapping and interpenetrating phases that capture systemic relationships: eotechnics (powered by wind and water), paleotechnics (concerned with mining fossil fuels and ores), and neotechnics (defined by inventions that change the nature and storage of energy). In addition, an era of biotechnics is on the horizon, human forms and capacities inform technological design. While this parsing of the phases maps onto conventional representations of human history, Mumford emphasizes changes in the qualities of the “technological complex.” Geddes (1949) originally conceptualized these phases for an audience of planners, who at the time confronted existing industrial wastelands and crowded living conditions in and around factories in rapidly urbanizing landscapes. Mumford makes an important addition to his mentor’s, the sociologist and planner Patrick Geddes, concept of phases of the development of “technological complexes.” Mumford’s chronicle of the complexes builds a narrative to explain why it is that machines now seem “to have a reality and an independent existence apart from the user” (1963, 332).

As in Geddes’ history of technology, Mumford’s earliest *eotechnic* phase encompasses a water, wind and wood powered economy. Handicraft and a close connection with agrarianism drive innovation, but the basis for expansion in industrial trades begins at this time. The end of this era marks the dissolution of guild trade work and the beginning of wage work. This signals a change of habit and mind toward labor in

general and characterizes the shift in production and innovation away from the creative mind. In *Pentagon of Power*, Mumford remarks:

Already this mode of conditioning has created a new psychological type: one bearing almost from birth the imprint of megatechnics in all its forms: a type unable to react directly to sights and sounds, to patterns, or concrete objects, unable to function in any capacity without anxiety, indeed, unable to feel alive, except by permission of command of the machine and with the aid of extra-organic apparatus that the Machine-God provides. (1970, 284)

The connection between collective capacities and innovation, which Mumford dubs the megamachine, is obscured as systems and society become larger and more complex.

*Paleotechnics* comprise the next era, stretching roughly from 1700-1900. This epoch is characterized by great shifts in population and industry. “Carboniferous capitalism,” coal and iron mining, are central symbols and subjects. These furnish fuel and shape both labor and social life suitable for the industrial revolution, preparing the stage for public demonstrations of and markets for progress in the form of World Exhibitions.

Here Mumford also describes the invention of the steam engine and its impact on the economy of energy generation, having social and political consequences. While the wind and water used for energy in eotechnics are free, steam power introduced “monopoly and concentration” of labor (Mumford 1963, 151). Machines to convert the potentiality of energy housed in coal were extremely expensive to manufacture and operate, thus the shape of manufacturing was consolidated and the scale and intensity of operation increased.

*Neotechnics* are the third (and still evolving) technological complex to develop in the past thousand years, marking what Mumford considers ‘a mutation’ from the previous

epochs (1963, 212). Its approximate beginning is in 1832, with Fourneyron's invention of the water turbine. Additional key scientific discoveries that make this new complex possible occur by 1850, including the electric cell, the storage cell, the dynamo, the motor, the electric lamp, the spectroscope. By 1900, complementary modes of communication, amplification and transportation - in the power station, photograph, moving pictures, gasoline, steam turbine and airplane - are envisioned if not completely realized (1963, 214). The societal and political structures that governed both paleotechnics and eotechnics still shape the transitional atmosphere in this new complex, placing society in what Spengler calls a 'cultural pseudomorph' (1963, 265), in which vestigial ways of being, honed at earlier times, obscure new possibilities.

Pseudomorphism as a complaint in *Technics and Civilization* is akin to contemporary conceptions of "path dependency" where prior sociotechnical structures shape new ventures and in some cases predetermine systemic arrangements.

There is also a fourth complex that Mumford anticipates called *biotechnics*. It is mentioned as a foil for megatechnics in the earliest and more optimistic book, *Technics and Human Civilization*, and returned to in the *Pentagon of Power*. Biotechnics and references to design using human forms and capacities - organic capacities - is Mumford's model for the possibility of technologies designed for ecologies and modeled on evolutionary change.

Mumford's description of the megamachine emerges out of this earlier depiction of technological development as a series of intersecting and overlapping periods characterized by the syncretic assimilation of disparate cultural influences in *Technics*



*and Civilization* (1963, 107). The early work on technology lays out three key forces that give shape to the megamachine: the problem of mechanization, the role of scientific knowledge in the structure of society over time, and the importance of particular materials of production as these proliferate and are embedded in and across the phases.

## **MECHANIZATION**

Mumford's work on technology, above all else, eschews the forces of mechanization. This distaste for mechanization is at base a resistance of the idea of universals, precisely because a universal form forces living things to conform to a rigid template. Qualities and behaviors that do not fit the mold languish, atrophy, or go extinct. The forces of mechanization which include science and its knowledge constructs as well as material objects, like the clock, which make concrete particular conceptions of reality and of time, constitute a reality wherein discrete demarcations, separations between subject and object, and abstract ideas bound our experience.

### ***The Clock***

In addition to the development of scientific principles that set the standard for mechanical production, Mumford reflects on the clock as an important material object that both figuratively and literally regiments time. In an oft quoted passage, he remarks "the clock, not the steam engine is the key machine of the modern age" (1963, 14). Prior to the 1300s men took hold of the passage of time with sundials and water clocks that could be confounded by cloudy days or other natural perturbances. The mechanical clock,

which appeared in Benedictine Monasteries and then moved outdoors onto the towers in medieval town squares, marked the timepiece's rise to prominence in village life.

Crucially, time could now (literally) hover over daily activities, just as the clock tower face over the town square, independent from particular natural impulses and influences.

While the work on technology contains this author's canonical treatment of the clock, another of Mumford's earlier works – a literary analysis of the novels of Herman Melville (1929) – harbors a suggestive passage that also centers on the significance of clocks. Pierre, Melville's adolescent protagonist in the novel by the same name, is hastily making his escape to New York with a new wife and finds a torn religious pamphlet. This bit of ephemera, "Chronometricals and Horologicals," is the vehicle for what Mumford identifies as Melville's moral center for the novel, *Pierre: or the Ambiguities* (1930). Mumford interprets this remarkable snippet with a similar spirit to that which we see in his work exploring utopias and the work of American transcendentalists. The pamphlet lays out a sermon on ethical behavior, through the analogy of chronometers and horologes, where chronometers are Earthbound Christians following a completely virtuous path in life, with their eyes on the divine watchmaker. Most men, however, follow horological time, meaning that they do the best they can to be ethical and to take action that is just, with the understanding that it is not practicable to attempt to avoid all sin. "And thus, though the earthly wisdom of man be heavenly folly to God; so also, conversely, is the heavenly wisdom of God an earthly folly to man. Literally speaking, this is so" (Melville 1930, 212). Pierre finds the religious pamphlet at the moment in

Melville's novel when he has resolved to set the bar high for himself. He aspires to be a heavenly chronometer, setting divine expectations of himself that are perhaps too high.

Mumford criticizes Pierre and (to the extent that the protagonist stands in for the novel's author) Melville himself for not being self-reflexive enough to realize that local watches matter, and that situated knowledge calibrated to the Greenwich Mean Time is at base the most complex challenge for mortal men. Unfettered bids for the utopic or transcendent are the evergreen targets of Mumford's criticism. Consistent with the earlier observations about mechanization, Mumford shuns mechanization because it encourages the adoption of universals whose form requires behavior too austere for a living organism to achieve. Mumford makes the point that clocks created the possibility of shared human experience and ultimately for science to produce truths about the world that could exist outside of situated experience. At the same time clocks validate universals, they serve as a reminder of human finitude and mortality (Ezrahi 1990, 150). The apportionment of time, as we will see later in the extended treatise on the megamachine, makes possible the synchronized capacities for labor, economic exchange, politics and the fashioning of materials that men build in the name of progress.

Mumford gives us the clock as an agent regimenting time, and, with the same intent, treats science and the scientific method and its ordering impact on the machined. Mumford declares "the clock is not merely a means of keeping track of the hours, but of synchronizing the actions of men" (1963, 14). Clocks regularize experience and with them the notion of dividing, saving and extending moments in the day becomes a reality. The apportioning function of clocks links directly to the invention of candles and lighting

that allowed people to work into the night and use more of the day. The human organism that once ate and drank when hungry and thirsty now regulates those biological functions by the clock in the form of breakfast, lunch and dinner. Perhaps most profoundly, the clock moves human activity into a space that is not situated explicitly in lived experience. Mumford asserts that clocks apportioning time as a mechanizing agent make way for the development of methods for making manifest other universalities. Clocks, then, do two definitive things to human experience: they allow for the coordination of the activities of people across space and regardless of location, and, in doing so, allow for time to be experienced as a universality. The most influential universal in modern life is the development of scientific methods and understanding.

### *Science*

One may perhaps over-rate the changes in human behavior that followed the invention of these new devices; but one or two suggest themselves. Where as in the eotechnic phase one conversed with the mirror and produced the biographical portrait and the introspective biography, in the neotechnic phase one poses for the camera, or still more, one acts for the motion picture. The change is from an introspective to a behaviorist psychology... (1963, 243).

A key reason why our current arrangements bend inexorably toward greater complexity under the guise of “innovation and progress” is precisely because the apparatus for developing and making the instruments and implements of modern life is tied to particular sets of ideas. Historians of science have argued that the rise of science during the 17<sup>th</sup> century brought about a mechanized view of the natural world. Many have argued that the increasing scientific and technical complexity of all corners of society over the last 100 years is the result of the development of a rational scientific

worldview and subsequent sets of practices, methods of inquiry, and regimented habits of labor, consumption and politics (Foster 2000; Leiss 1994; Merchant 1980; Shapin, Schaffer, and Hobbes 1985; Mumford 1970). Ezrahi demonstrates the relationship between scientific knowledge and political power (1990). Though Mumford's discussion of mechanization traces the development of industrial material culture, he also suggests that its origin may begin in ritual and magical practices of primitive man, with ritual prototyping the repetition, order and predictability that would undergird the forces of mechanization in the megamachine (Miller 1990, 160). Given the linkages that Mumford makes between mechanization, timekeeping, and the development of science laid out here, it is tempting to condemn this man as anti-science, anti-logic, and irrational. In reality, Mumford's view of scientific knowledge and practice is far more nuanced. This textured relationship between the scientific as a driver for innovation must be taken into account if we are to apprehend the significance of the megamachine and, further, bring the metaphor into conversation with TA practices. Mumford asserts that the evolutionary characteristic of the human brain --consciousness, and resulting creative impulses-- require a counter imposition of order:

Through long, difficult, constructive effort man fabricated a cultural order that served as a container for his creativity, and reduced the danger of its many negative manifestations. But it was only by a multitude of experiments, discoveries, and inventions, lasting over hundreds of thousands of years and involving much more than tools and material equipment, that man created a culture sufficiently exhaustive to make use of even a part of the brain's immense potentialities. That development in turn brought its own dangers and disabilities. (1967, 1:41).

In Mumford's view, science as a practice and as a framework is important for enlarging the distributed intelligence of humans as a species. Its existence, even with its associations with a mechanized and routinized practice, is a kind of architecture that allows for greater reflexivity and expanded ways of knowing. This is the paradox of creativity and requisite ordering that allows for humans to take advantage of the creative mind (painted darkly in the later books) linked to a successful interpretation of key ideas in Mumford's work. Collective capacities developed to extend the perception and minds of humans' narrow experience, but at the same time beget new creative possibilities that have not existed before.

These examples frame the history of technology that unfolds first in *Technics and Civilization* and later informs the megamachine as metaphor for the interaction of collective capacities and technics. Taken together the clock and the methods of science push mechanization into material, temporal, and methodological dimensions of experience.

### ***Materials***

Mumford's exploration of the qualities of materials used for production precedes but also permeates his concept of the megamachine. Several significant passages which investigate the elemental characteristics of materials in *Technics and Civilization*, much in the way of Melville's digressions on whaling in *Moby Dick*, represent the author's attempt to characterize the change in individual and social psychology and behavior with

respect to consumable materials in the world through an examination of material properties.

Mumford's treatment of materials throughout the work on technology, and in particular in *Technics and Civilization*, supports a structural symmetry contained in the descriptions of the technological complexes. He asserts "almost any part of a technical complex will point to and symbolize a whole series of relationships within that complex" (1963, 110). I have already recounted the emblematic technological developments in each epoch; here I address the function of Mumford's description of materials. For Mumford, the raw materials that make up consumables in the world have elemental properties that can be re-arranged as these materials are reshaped through industrial production: "modern technics, by its own essential nature, imposes a great purification of esthetics: that is, it strips off from the object all the barnacles of association, all the sentimental and pecuniary values which have nothing whatever to do with esthetic form, and it focuses attention upon the object itself" (1963, 353). Later in this chapter I will link this description of materials as they manifest in modern technologies with Heidegger's concept of 'enframing,' and will reference Bruno Latour's subsequent critique of enframing in *Pandora's Hope* as I unpack the notion of transformation in the context of Mumford's megamachine. For the moment, let us appreciate Mumford's depiction of elemental materials of Mumford's technological complex. The materials I consider here are iron and glass. Mumford captures the capacity of objects to change human perceptions, psychology and behavior. The elemental properties of materials express

themselves through the objects of consumption in that they become and in turn impact human relationships.

In particular, Mumford selects materials that enjoy ubiquity in consumables during one or more of the technological complexes. In the example of iron in the paleotechnic, iron is at once ubiquitous and difficult and costly to fashion into machines and artifacts. Mumford also links the qualities of working with iron ore to the labor required to fashion machines, tools, and military power using this material. Working with the material itself requires intensive amounts of energy. Maintaining tools and objects made of this material require constant attention lest it rust away (1963, 165-167). The cumbersome nature of the material accordingly shaped production, labor, and the behavior of consumers. These arduous requirements for shaping iron in the paleotechnical complex drive subsequent innovation to explore new materials, forms and uses. This description of the influence of materials on production, labor and everyday life is an example of what Mumford terms a “syncretic” (referring to the act of combining different and sometimes contradictory impulses) negotiation between culture and technology that forms the basis for new innovations, or progress.

In the depiction of glass we move from a private view of ourselves looking in the mirror, in the eotechnic phase, to a public self, as when we look at others through a window. The use of glass in building allows us to control our environments and, importantly, to extend the workday. Glass also becomes a crucial material in instrumentation in astronomy, chemistry, and other sciences. Finally, cameras and motion pictures created through glass lenses make private lives public. In short, Mumford asserts



that as the uses of glass proliferated in our built environment, our inner selves changed as well: “glass had a profound effect upon the development of the personality; indeed it helped to alter the very concept of the self” (1963, 128). Mumford’s take on glass provides a way in to thinking about a key concept that will drive the third chapter of this work – the concept of reflexivity in the context of Technology Assessment (TA). The very technologies that we contemplate in TA change the quality and focus of self and of public reflection.

Thus the very presence of technologies and their materiality changes the nature of the conversation and the quality of both self-knowledge and collective understandings of political and civic life. Mumford repeats that this change, though nuanced and evolving, is unsettling because the phenomenon that characterizes the labor, society, and culture that makes these massive production projects possible is rooted in a process that narrows the scope of experience: this process is mechanization. For Mumford, mechanization narrows the range of possible creative acts and ways of being and channels social energies in very particular ways, which in turn have psychosocial impacts.

## **THE MEGAMACHINE**

“The megamachine” is the central organizing metaphor of Lewis Mumford’s *Myth of the Machine* series. It describes the relationship between organized labor, knowledge and power through institutions and technical innovations in society. The metaphor of an “[innovation] system made up of interchangeable parts, inanimate and animate, human, mechanical, and institutional, centrally organized and controlled” makes

vivid a phenomenon that shapes modern society and produces persistent negative psychic, political, social, and ecological effects (Hughes and Hughes 1990, 10). Mumford identifies five qualities that define this phenomenon: its physiology of human parts; its bureaucratic structure; its objective organization of knowledge; and its orientation toward coercive power and processes of transformation that generate a myth of progress.

The megamachine's chief characteristic is in its collective capacity to erect new material things in the world through the dynamic energies of routinized labor. Mumford calls this early labor machine "invisible" because the potential for it rests in human bodies rather than in externalized tools and contraptions. It is a labor force that has moved decisively away from artisanship towards specialized interests and training. Bureaucratic management and governance mechanisms through institutions, organizations, the state and coercive leaders transmute labor in this direction. Like Weber, who imagined the diffusion of power through organizational hierarchy, Mumford too traces the development of the megamachine first at the hands of divine kings and next through the banal routines of management. The megamachine's rigid infrastructure sets the terms and conditions for all of the experiences and innovations that result from it.

This rigid choreography of social and brick and mortar arrangements is informed by a public consciousness conditioned by particular topologies of knowledge. Scientific reasoning pursued in order to ferret out facts about the natural world and the laws of nature and physics begets practices that create and substantiate the idea of objectivity. Science, as Mumford shows in an extensive historical tour through the great thinkers and experimenters, invents the idea of the universal. It measures out and, by measuring,

standardizes aspects of human and environmental experience and renders them more useful for the labor machine. The dramatic scale of routinized production during the industrial revolution further privileges scientific and technical explanations of the world.

The pyramids at Giza are an important historical instantiation of the megamachine. What makes them the ultimate example is that they are erected in the absence of sophisticated technologies and the presence of an elaborate division of labor. This labor force compelled by a king with divine attributes engineers a gigantic structure with extreme precision, and the sheer force exerted by a king with divine attributes to compel the construction (Mumford 1966b). What is more, the “invisible machine” of labor in Pharaonic times was detached from “any fixed external structures, these labor machines had much fuller capacities for change and adaptation than the more rigid metallic counterparts of a modern assembly line” (1966b,191). The pyramids are a particularly poignant example for Mumford because he believes that he captures a moment in the development of the megamachine where all the human parts are in place, but the connection to handicraft and to creative and divine influences that characterize artisanship are still conventions in peasant society. High technology is not what is needed to build great things; human ingenuity, adaptability, reverence for the spiritual, and coordinated labor drive innovation.

While literature on the social construction of technology draws its notion of the components of the sociotechnical from Mumford’s foundational metaphor, much of contemporary STS loses the aspect of critique of this system that Mumford intended to invoke. Mumford lays the groundwork for his critique of mechanized industrial society

by questioning the then dominant theory of human development based on an analysis of artifacts in the fields of archeology and anthropology:

[T]he stone or pottery artifact came to be treated as self-existent, almost self-explanatory objects... The fact that such durable artifacts could be arranged in an orderly progressive series often made it seem that technological change had no other source than the tendency to manipulate the materials, improve the processes, refine the shapes, make the product efficient. Here the absence of documents and the paucity of specimens resulted in a grotesque overemphasis of the material object, as a link in a self-propelling, self-sustaining technological advance, which required no further illumination from the culture as a whole even when the historic record finally became available (Mumford 1961b, 231).

Mumford launches a critique of anthropological and archeological analysis of human development through the examination of artifacts, saying instead that a look at the human capacities that were necessary to imagine and fashion tools would tell a different but parallel story about how humans evolved relevant to their technologies. The received knowledge is that man is a tool-making animal. Mumford believes that leaning on the artifact excluded creativity and spirituality from the conversation and has significant ramifications not only for contemporary social scientific theory, but also for the modern self-concept. The two elements at the epicenter of this critique are, firstly, the charge of “distortion of evidence,” meaning that stone tools persist for us to find today and thus represent the core of our analysis of human development in ancient cultures, leaving a multitude of other organic items that surely existed in a secondary role.

Second, a heightened sensitivity towards artifacts for hunting, building and war confirms our modern preoccupation with technology, but not necessarily the centrality of those activities in ancient life (Mumford 1966a, 305). In short, Mumford charges that we examine artifacts and miss the significance of human capacities that weren't readily

available to unearth. Seeing this significance could help contemporary investigators theorize the power of increased cognitive power and imagination, language, and the transmission of information. These factors all contribute to collective capacities and, by extension, to the creation of new sociotechnical arrangements. This focus on the artifact continues to be evident in contemporary life in the practice of TA. I will take up a critique of this practice on the same grounds in Chapter Three.

One way to interpret the megamachine is to see it as a critical view of modernity that is in opposition to Mumford's ideas of organicism, which he linked to favorable markers of the evolution of consciousness: "the increase of sentience and self-directed activity, lengthening of memory, expansion of consciousness, and exploration of organic potentialities in patterns of increasing significance" (Mumford 1967, 31). Mumford's organicism can be found by association throughout his work in the descriptions of natural human limits, abilities, perception of time and space, as well as psychological health. Mumford's organicism, contra other theorists (such as Veblen in his time), conceptualizes social activity in an atmosphere of resource abundance rather than Malthusian scarcity (Casillo 1992). Organicism leads to an integrated society. In contrast to the organicist vision, the megamachine applies pressures of various sorts, not least rational, scientific structures and organizational routines, to shape collective behaviors in various ways. Subsequently, this disjuncture between mechanized reality and organicism informs Mumford's approach to urban planning and to architecture. In fact one could say that organicism for Mumford is everything that the megamachine *is not*. Organicism is in opposition to highly regimented experiences coerced by power.

For Mumford, these scientific and technical developments, taken together, amount to a culture of mechanization that influences crucial power relationships at all levels of society and imprints itself in technological forms and human psychology. The megamachine should not be understood as a fixed state, but instead as an engine of transformation that aligns with contemporary understanding of the culture of innovation. Progress is one way of conceptualizing and orienting time that, Mumford explains, becomes a fixed epistemic condition focused on continual improvement that eclipses the possibility of the existence of other modes of human activity.<sup>2</sup>

## **INTRODUCING LATOUR AND CANETTI**

The next section outlines and extrapolates from Mumford's model to put two traditions and methodological developments into conversation with Mumford's metaphor. These two texts are Elias Canetti's *Crowds and Power* and Bruno Latour's *Pastuerization of France*. These two authors analyze the nexus of collective capacities and power as a central concern in STS Theory. Both treatments, of crowds and of actant networks, thwart the conventions of competing contemporary theory. I show how Canetti's focus on the affect and materiality of aggregates and Latour's democracy among actants, when added together, advance both the concerns and the possibilities of moving beyond the limited sociotechnical relationships defined by the megamachine. To do this, I utilize Latour's definition of actants and Canetti's crowds to offer novel interpretations of two established ideas about the behavior of crowds and about the undue influence of technological

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<sup>2</sup> Mumford provides a useful distinction between progress and evolution in *The Pentagon of Power*, p197.

systems on human behavior. The first idea is the dominant notion in social theory that crowds are a harbinger of unfettered violence and need to be controlled. The second is an all but discredited idea of technological determinism: a theory that presumes that a society's technology drives the formation of its social structure and cultural values. The concluding section of this chapter reflects on how these how these elements intersect and contribute to an updated model: the soft megamachine.

### ***Latour's Actants***

In his review essay, Historian Simon Schaffer (1991) likens Latour's *Pasteurization of France* to Marx' *Eighteenth Brumaire of Louis Bonaparte*. Both texts share a unified purpose to “decompose” the reputation of these two great men. To this aim, Latour adds his intention to “return freedom of action to all the agents of French society”(1988, 22). To realize this “take down” of Pasteur, Latour pours over each issue of three publications: the *Revue Scientifique* from 1870 to 1919, “a general weekly review founded in the mid-nineteenth century and written by scientists themselves for a wider educated public, falls somewhere between Scientific American and the general-interest pages of Science” (1988, 11); the *Concours Médical*; and *the Annales de l'Institute Pasteur*, the official journal of Pasteur's home institute. Though he employs archival methods, Latour claims that the value of this work is not historical; primary source material provides the content and context for unfolding a novel methodological approach that takes “absolute concreteness” as a foundational precept.

For Schaffer, Latour's account of Pasteur's stardom in the history of medicine follows in the tradition of Marx's historical materialism. Latour upholds much of the usual interpretive conventions of the sociology of scientific knowledge (SSK) but with an important exception that Schaffer reads as a 'scathing critique' of SSK.<sup>3</sup> The inanimate animal, vegetable and mineral have life force and thus intentionality, a trait that Schaffer calls hylozoism (1991, 181).<sup>4</sup> 'Actants' in French society include countrymen and women; however texts, groups of incited hygienists, the Imperial regime, statisticians, and infectious microbes seep into view as well. *Pastuerization of France* further specifies the role of non-human actors in the method that is now a contemporary hallmark of STS: Actor Network Theory (ANT). Two distinctions in this work, the importance of non-human actors and Latour's representation of power as an artifact of resistance, are important for deepening our understanding of the megamachine.

Schaffer critiques Latour's hylozoism on the grounds that ascribing intentionality to microbes as somehow "preferring" the Pastorians over other competing scientists of the day gives many important controversies that SSK would emphasize "the slip." Schaffer (1991, 189) charges that "Hylozoism directs our attention towards the items whose action is in dispute.... [and] directs our attention away from the forces which help close that dispute," namely scientists with competing views, their colleagues and institutions and the weight of their professional reputations. I introduce Latour's text

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<sup>3</sup> SSK is the study of science as a social activity.

<sup>4</sup> By intentionality, neither I nor Schaffer, mean to imply animism, attributing an anthropomorphism to objects, but rather the application of the term is an attempt to describe how the non-human is engaged and implicated in a given relationship in the world.



through Schaffer, one of its critics, to highlight the distinct differences between SSK then and the particular project that Latour continues in contemporary work.

Latour's philosophy, still unfolding at the time of writing *Pasteurization of France* (in 1988, following *Laboratory Life*) is a radical reinterpretation of the metaphysics held by prominent philosophers of modernity. *Pasteurization* applies a method for research design and analysis to question the origins of Pasteur's fame. While Latour's method has many facets, the most important aspect for aiding the interpretation of Mumford's megamachine is the systematic discussion of why "there are more of us than we thought": why microbes emerge as important actors in shaping society. This assertion opens the door to a different sort of accounting of the influence of collectives and material technologies on the shape of society. Non-human and material things factor in the creation of sociotechnical systems here in a way that harkens back to the push and pull of Mumford's early work that he later revises through the introduction of collective capacities and their shape in the megamachine.

Philosopher and self-proclaimed "object oriented ontologist," Graham Harman (2009), devotes an entire volume to aiding our understanding of Latour's actants and spends considerable time with the second part of *Pastuerization of France (1988)*, calling it the most concise early statement of Latour's philosophy. This second section, called *Irreductions*, has four central ideas from which the others branch:

- *Irreduction*: The idea that no object is inherently reducible or irreducible to any other.
- *Actants*: The world is made up of *actors* or *actants* that lead a democratic

existence: all actants have the same ontological value and are “real.” Actants are irreducible objects that can be human, non-human, individuals, aggregates, or bodies of knowledge.

- *Translation*: This refers to the actions that actants take to form and negotiate associations. The process of translation is ongoing and is necessary to assure an actants’ existence.
- *Alliances*: Relationships between actants constitute the relative strength or weakness of a given actor.

Taken together, “absolute concreteness” is the common denominator across the four qualities (Harman 2009, 15). Latour’s position is in opposition to the metaphysics of Husserl, Heidegger, Derrida, Russell or Quine precisely because these others “reduce objects to our human access to them” without allowing them agency apart from our perception of them (Harman 2009, 25). Here is where the tension I have outlined in Mumford is in harmony with Latour’s sentiments. Latour also discredits the concept of potential or possibility. Each actant is always fully participating and holds nothing back for use later from moment to moment. Therefore, symbols can exist as actants, but don’t stand for or invoke a hidden other reality. Another way to put this is that an actant’s power or strength is not the result of stored resources root-cellared for use at the right moment. This idea has some important consequences for our understanding of determinism or the concept of “technology as legislation,” both of which are the basis of criticism about the pace of innovation by critical theorists of technology. In both views, technologies are a governing force in society independent of people who control them.

Under Latour's definition of actants, the idea that technologies represent a type of legislation, possessing a reserve of power or influence independent from interaction in the network, does not hold up. The point about potentiality has interesting consequences for our idea of the strength of the megamachine in structuring human experience toward a particular outcome. I revisit this conundrum in the final section here on transformation to suggest that material technologies as actants can drive history in concert with organic collective capacities.

### ***Canetti's Crowds***

Despite the interval separating their births, Lewis Mumford (b. 1895) and the Nobel Laureate Elias Canetti (b. 1905) are figures forged from the same rare elements and have experiences of both momentous and dastardly events of the twentieth century in common. Like Mumford, the Bulgarian born Canetti is an omnivorous thinker; one critic places him "among the most deterritorialized intellectual ever" (Brighenti 2010, 294). Árnason calls the work I will turn to now, *Masse und Macht, or Crowds and Power*, published in German in 1960 and translated into English from the German in 1962, "hermetic" (2004), reflecting the boldly original language of this novel. A Sephardic Jew of Spanish descent born in Bulgaria in 1905 and a writer of the Diaspora, Canetti sought to make sense of a crumbling European Jewish society in the holocaust: a tragedy of such magnitude that only unorthodox methods could begin to make sense of the "Nazi degradation of the human" (Farneti 2006, 730). If the sweep of Mumford's work on technology is a grand pageant, Canetti's gaze into the essence of crowds conjures a fabled "fight club" as he

unpacks even the most unmentionable of human urges to lay bare just how flimsy the demarcation is between human and animal:

The psychology of seizing and incorporating, like that of eating in general, is still completely unexplored. We tend to take the whole process for granted and never reflect on the mysteriousness of much that occurs in the course of it. There is nothing about us which is more strongly primitive. It is something we share with animals, but even this strange fact has not so far made us pay more attention to it.

The approach, with hostile intent, of one creature to another falls into several distinct acts, each of which has its particular traditional significance. First there is the lying in wait for prey; the prey is marked down long before it is aware of our designs on it. With feelings of pleasure and approval it is contemplated, observed and kept watch over; it is seen as meat whilst it is still alive, and so intensely and irrevocably seen as meat that nothing can deflect the watcher's determination to get a hold of it. Already while he is prowling round it he feels that it **belongs** to him. From the moment he selects it as his prey, he thinks of it as incorporated into himself. (1962, 203) [Emphasis in original]

*Crowds and Power* grasps, claws and gnashes its way through the crowd in history. The book's chapters are arranged in short vignettes that reference works from Herodotus to the *Golden Bough*, Lefebvre and the Russian revolution, European travel diaries in African and India, and ethnographies of aboriginals and pygmy tribes. What is not present is the direct target of Canetti's critique: the major crowd theorists in history and of his day, Le Bon (1995), Freud (1922), and Tarde (1901). Demagogues are similarly absent – the notorious rabble rousers who in the early part of the twentieth century bent multitudes to execute tragic deeds. Paradoxically, *Crowds and Power* achieves authority by daring to look away from the horror show of the day; instead its otherworldly prose employs at once myth, folklore and ethnographic research of primitive peoples to uncover the natural law of group formation. In addition, though there are chapters on

hunting, gathering, feasting, mourning, war and conquest, there are few, if any, discernable mentions of tool use or of the augmentation of crowds through technologies. Taken together, the laser focus on collective experiences and the insistence on materiality over symbolism constitute a powerful internal logic that goads the reader to discover something altogether different about crowds. Canetti's novel characterization of crowds is useful for taking further our understanding of the other modes that collective capacities can form, beyond those prescribed under the megamachine. This alternative view of crowds is also, as I will discuss in Chapter Four in my analysis of a new environmental social movement, germane to interpreting the emergent and convergent passions of crowds that can bring about a non-violent Arab spring, but which are ignored by the methods and framework of contemporary TA.

Canetti writes this natural history of crowds, *Mass un Macht*, over a period of thirty years and in the aftermath of two world wars as a way to talk about the influence of mass delusion in the systematic and syndicated genocide of the Jewish people, as well as the crushing totalitarian regimes that erupted in war. He also embarks on an exploration of crowds that immediately jags away from the dominant treatment of them by Le Bon and others who theorize crowds as monolithic, as the irrational precursor to violent mobs, to revolution and to destruction. Shaping a 19<sup>th</sup> century conservative fear of crowds (Brighenti 2010, 293), Le Bon (1995), among others, led the charge in a wave of criticism against enlightenment rationalism linked to Platonic ideas. These authors use crowds as the totem for irrationality that permeates human nature so completely that any attempt to adhere to an enlightenment ideal is invalidated as Sisyphean (McClelland

1996, 6). What is more, crowds in their irrationality necessitate authority and control. “Indeed, behind the fear and hate of crowds as politically destabilizing phenomena, there lies a much deeper concern, namely the fact that the crowd is a type of social entity that inherently threatens the physical and psychic boundaries of the individual. Not only is the crowd a dangerous political subject, it is also an outrageous epistemological object” (Brighenti 2010, 294). It is precisely this treatment of the crowd as an epistemic entity that brings Canetti’s thinking in line with Mumford’s project to define and call out a particular type of crowd that gets wrought through the megamachine.

Canetti grounds his interpretation of the individual in the Hobbesian sensibility of “all against all.” The opening line reads “there is nothing that man fears more than the touch of the unknown” (1962, 15), foreshadowing a later extended treatise on the insatiable drive to survive. Boundaries of the individual body dissolve in the crowd and signal, at times, the transcendence of the nasty and brutish experience of a Hobbesian existence (Honneth 1996). Thus Canetti lays his own vision of crowds on the table in opposition to a Hobbes/Le Bonian version of crowds as conjured and controlled by mass leaders (McClelland 1996, 25) or influenced by Darwinian notions that necessitate a eugenic response to change or eradicate whole groups of people in the grounds of their genetic inferiority (McClelland 1989, 294). Honneth (1996) complains that Canetti’s crowd fails utterly to account for human interpersonal bonds. This is precisely because Canetti wishes to develop a sensitivity in his reader for the influence of the collective. We unfocus our eyes from a conventional accounting of humanness as originating in the individual. Crowds are not even reserved exclusively for the human, “crowd symbols”

also exist: ‘collective units which do not consist of men but which are still felt to be crowds,’ (1962, 75). Crowd symbols include forests, fire, the sea, fields of corn, rain and, cryptically, several varieties of heaps. Canetti describes each of these natural collectives and their attributes to demonstrate that human crowds mirror the qualities of these non-human collective entities. For example, the sea is

multiple, it moves, and it is dense and cohesive. . . . The dense coherence of the waves is something which men in a crowd know well. It entails a yielding to others as though they were oneself and them. There is no escape from this compliance and this the consequent impetus and feeling of strength is something engendered by all the units together. The specific nature of this coherence among men is unknown. The sea, while not explaining it, expresses it (1962, 80).

This seeming detour into talking about natural collectives that “feel” like mobs of people is Canetti’s way of creating a set of sensitivities and, subsequently, descriptive language packed with tangible and affective energy to capture the breadth and depth of collective capacities that crowds possess as unique social units. This is what crowd symbols are. Though Canetti does not include a reference to machines directly, using Mumford’s metaphor of the megamachine, I assert that technological systems can also be counted as crowd symbols.

Rendering collectivity as a unit of analysis is a shared concern in the three models of collective capacities in Mumford, Canetti and Latour. This approach is a crucial criterion that, operationalized in chapters three and four of this dissertation, illuminate how technologies come into being along directions that produce undesirable outcomes. Canetti makes an important contribution to the interpretation of the megamachine precisely because his writing confounds the conventions of what has become a dominant

analytic approach in the social sciences. “Such conceptual hegemony – transcribed into and supported by common sense – makes it difficult even to perceive how unstable and shaky the category of individual is as a building block of the social. The burden of proof is reversed and completely – one may also add, unfairly – assigned to the holos. In one and the same move, the individual is presented as the natural unit of the social, and the collective alone is assumed as in need of explanation” (Brighenti 2010, 295). If Mumford could interject here, he would say that we need not only an explanation of the collective but also to account for the crowd as it is metamorphosed through its transformations of material forms and technologies.

Within this turn towards the whole, Canetti does not describe a crowd with universal qualities, but instead as a multiplicity: a social entity that is “neither an individual nor a group, yet it is to be regarded as a social formation” comprised of encounters and linkages rather than subjects or objects (Brighenti 2010, 292, 300). Canetti identifies a typology of crowds based on four attributes and five types of emotional affect. The attributes are: 1) The crowd always wants to grow; 2) Absolute equality; 3) a love of density; 4) a need for direction and a goal. Emotional types are bating, flight, prohibition, reversal and feasting crowds. The dimensionality of crowds and their emotional pastiche conveys the texture and diversity of collective behavior that opposes other portraits of crowds as a singular phenomenon.

Further, Canetti traces the lineage of today’s crowds to primitive packs: “among the small hordes which roam about as bands of ten or twenty men it is the universal expression of communal excitement” (1962, 93). There are four kinds of pack: hunting,



war, lamenting, and increase. Among these the increase pack stands out as a “way in” to how technology as a form of consumption intersects in the life of crowds.

It is certain that man, as soon as he was man, wanted **to be more**. All his beliefs, myths, rites and ceremonies are full of this desire.... For, originally, man does not think of his own increase detached from that of other creatures. He transfers his desire for increase to everything around him. Just as he wants the enlargement of his own horde through a plentiful supply of children, so he also wants more game and more fruit, more cattle and more grain, more of whatever he feeds on. For him to prosper and increase there must be plenty of everything he needs to live. (1962, 108).

I will address this link between this primordial *impulse for increase* and the concept of *transformation* in the final section of this chapter as an important facet of the megamachine. Technology has the most significant role to play in amplifying and mutating the crowd state where the desire for increase and the moment of transformation intersect.

## **READING THE MEGAMACHINE**

The next section outlines the components of Mumford’s megamachine in more depth along its aspects of human parts, bureaucracy, organization of knowledge, locus of power and transformation. I associate principles that define Latour’s actant networks and Canetti’s crowds with each of these aspects. I also compare the evidence with which each writer supports his assertions: Mumford through his critique of a techno-centric interpretation of human development, Canetti with his use of mythology and primitive tribal practices, and Latour’s historical case study of French bacteriology. I then describe how each author treats the concept of transformation as this relates to technology.

## ***HUMAN PARTS***

Mumford asserts that the earliest technological complex is composed of tools that extend “man’s own organs for pushing, pounding crushing, cutting and stabbing” (Mumford 1966a, 305.) For Mumford, “human parts” define the inflection point of the human/machine relationship. Divine kingship through force first consolidates and scales up this machine to tackle highly organized projects. Mumford makes a succinct description of how the megamachine is made of human parts in a reference to armies under military conscript and also to the industrial labor force:

If a machine be defined, more or less in accord with the classic definition of Franz Reuleaux, as a combination of resistant parts, each specialized in function, operating under human control, to utilize energy and to perform work, then the great labor machine was in every aspect a genuine machine: all the more because its components, though made of human bone, nerve, and muscle, were reduced to their bare mechanical element. (Mumford 1967, 191)

Defining the megamachine as human parts directs attention to collective capacities rather than to the material technologies that are the artifacts invented through those talents.

However, Mumford thinks of human parts not as sinew and bone alone. The subjective and affective mind are key elements. Sensuality, physical pleasure and leisure, central to organicism, are integral to creative human life, and, though ephemeral, are essential components of innovation. The megamachine is a machine of human parts that omits the value of the subjective mind and orders its activities only towards the objective. Mumford charges that "in projecting one side [the objective one] of the human personality onto the concrete forms of the machine, we have created an independent environment that has reacted upon every other side of the personality," resulting in

megatechnics and in collective pathologies (324).<sup>5</sup>

Canetti also grounds his theories of collective capacities firmly in the body. While it manages to survive, the body hunts, consumes and digests others. In contrast to Mumford's vision, Canetti seldom mentions pleasure. Sex plays out instead as a continual animal craving (Honneth 1996, 13). Further, the impulses for pursuing, eating, digesting, and procreating in the individual are absorbed and morphed into an equalizing experience in the throng. Canetti assigns attributes and capacities to an aggregate in order to show that crowds as meaningful social units have many archetypical moods. Qualities of mobility and immobility qualify the attributes of growth and equality. These qualities are stagnation (indicative of a reluctance to discharge or disburse), and the imperative of rhythm: a crowd must be in perpetual motion. The last set of qualities are quick and slow crowds, indicating the velocity of the crowd relative to its goal. If a crowd of pilgrims desires a resting place in heaven, that particular crowd's goal is far off and so its nature is slow. The quick crowd, instead, has a near term and visible goal just within reach.

In contrast to the characterization of human parts given by Mumford and Canetti, Latour's actants encompass but move beyond human parts. Anything that exists discretely in a given moment is equally in play:

I use "actor," "agent," or "actant" without making any assumptions about who they may be and what properties they are endowed with. Much more general than "character" or "dramatis persona." They have the key feature of being autonomous figures. Apart from this, they can be anything – individual ("Peter")

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<sup>5</sup> The topic of collective pathologies is developed further by Gilles Deleuze and Félix Guattari (2001; 1987) in *Capitalism and Schizophrenia*, drawing on Mumford's insight.

or collective (“the crowd”), figurative (anthropomorphic or zoomorphic) or nonfigurative (“fate”). (1988, 252n11)

Calling actants a “unit of analysis” is a misnomer. Unlike bodies or crowds in the previous examples, actants are not “units” in a conventional sense, but rather exist through their active associations and frictions with one another in a network. In this way, an actant is a unique “event” rather than a thing or substance (Harman 2009, 17). In effect, Latour rejects the need for a particular “unit” or level of analysis and conceptualizes the relationship between humans & technologies as a landscape of flows, process, and negotiations among forces. Blok calls Latour’s symmetry between nature and culture a-humanistic (Blok 2011, 142). This view is useful for examining the megamachine because it confirms the possibility that technologies as actants can themselves influence human parts to change and evolve their capacities apart from conscious oversight, planning, or even as the consequence of neglect. Though it resists the definition of collective capacities as such, Latour’s actant networks leave open the possibility of their influence.

### ***BUREAUCRACY***

Like Weber, Mumford defines bureaucracy as “broad division of labor between functions and offices” (1990, 193). It has the related qualities of hierarchy, specialization, and regimentation, which define particular scaffolding for work and the character of innovation. Mumford locates the birth of bureaucracy in the activities of the ancient

progenitors of the megamachine: management by kingships and of military armies. Just as the products of technological complexes in history possess qualities that reflect the dominant modes of each complex, the megamachine's rigid infrastructure shapes the character of the experiences and innovations created under it.

In contrast to the megamachine, a type of crowd bent towards regimented material production, Canetti's is not a singular crowd. Canetti furnishes a fuller rhizomic view of what collectives can do and desire in the world. He makes room for multiple, non-hierarchical expressions of being. In light of Mumford's critique of the mechanized and narrow nature of the megamachine, crowds as multiplicities make other states, emotions and intentions of collective capacities possible in the aggregate. These moods are both terrible and menacing as well as reverent and transcendental. Canetti's account of crowds places the megamachine in context as one among many ways that collective capacities might be oriented.

Latour pushes past a conventional view of bureaucracy, claiming that systems do not exist as entities, only the practice and energy of systematizing:

For a system to exist, entities must be clearly defined, whereas in practice this is never the case; functions must be clear, whereas most actors are uncertain whether they want to command or obey; the exchange of equivalents between entities of subsystems must be agreed, whereas everywhere there are disputes about the rate and direction of exchange. (1988, 198)

There is no special power in setting up a factory or establishing a government agency or generating a workflow for laborers to follow. These actions are not more potent and have no more staying power than more ephemeral turns of events in the world. For Latour, the

bureaucratic model itself as a driver of innovation does not itself dictate a particular brand of production or consumption or quality of life. A bureaucracy exists if the human and non-human friction that continually makes the world into phenomena renders favorable conditions for institutions and hierarchies to come into being and to go on existing and having influence. This is where Latour as a philosopher and Mumford part ways. Mumford insists that this structure brings about systemic impacts.

## **ORGANIZATION OF KNOWLEDGE**

Objective facts, synchronized time and behaviors that underlie and incentivize the notion of progress underlie modern views of technological innovation and its outcomes. These notions, Mumford charges, directly relate to a particular organization of knowledge. For example, the invention of writing enables bureaucratic practices, which in turn makes the ‘machine’ of labor “operative for constructive tasks as well as for coercion.” Writing down a directive, rather than speaking it, establishes the means for accountability. Written language represents “action at a distance”: commands arrive through scribes and swift messengers who in turn aid in the encoding or decoding of the royal message (Mumford 1967, 192).

Mumford argues that there is a direct link between the development of scientific idea and practices as a specific type of organized knowledge, and the constituent parts of the megamachine. Mumford describes science as a “change in attitude towards nature.” He provides examples of science’s epistemic and practical advance by detailing the work

and influence of Galileo, Bacon, Descartes, Rembrandt, and others (Mumford 1963, 63). By linking together this history that Mumford seeks to demonstrate the relationship between the development of scientific ideas and the link to practical application and the expansion of the enterprise to represent and economic and material engine in society. Mumford underscores the importance of Bacon to this link and to the formation of the components of the megamachine with the claim that Bacon “foresaw... the coming impact of science as a corporate activity” (1970, 1:108). In effect, Bacon “closed the gap” between science and technics in his time and articulated a science of specialization, hierarchy, and application hundreds of years before it would be realized. Mumford especially treats Bacon’s (1938) future oriented vision in *The New Atlantis* as evidence that scientific practices indeed fuel and support a dynamism in technological development. Knowledge supportive of the megamachine bifurcates the real into objective facts that exist independently and those that stem from situated experience. In this way science partitions or constrains the world.

To glean how Canetti conceptualizes knowledge that constrains, we must turn to his description of “the command”:

‘An order is an order.’ Commands are by their nature final and categorical, and this may be the reason why so little thought has been given to the subject. They seem to us as natural as they are necessary and we accept them as something which always existed.... They make up a good part of what we call education and the whole of our adult life is permeated with them, whether in the sphere of work, or war, or of religion (1962, 303).

The biological foundation of the command is a death threat. Canetti adds that the aftermath of receiving a command, like being shot with an arrow, leaves a person

changed psychologically if he manages to survive. All our social relationships, families, and states are a domesticated form of this command. Despite a terrible fear of death, we humans allowed domesticated commands to come into being because we accepted food in exchange for obedience, just as a dog obeys its master. In other words, the hierarchical power relationships we accept in our lives as natural are the sources of implicit commands that structure our behavior in society. These social structures naturalize explicit commands that we could otherwise perceive as intrusive or aggressive and, subsequently, resist.

The epistemology of science, in Mumford's view, and the (domesticated) command, in Canetti's, are equivalent along a dimension that impacts social behavior and psychology. Canetti insists on the primal origins of control as embedded in our experience living in a society of domesticated command. This insistence on the influence of affective knowledge extends to the evidence Canetti marshals throughout *Crowds and Power* "play[ing] myth against the hateful technique of rationalization of what is beyond reason and normativity" (Farneti 2006, 729). Dominant knowledge structures in support of the megamachine resolutely quash sources of irrationality, myth, dream and emotion. Both Canetti and Mumford view these alternate modes as a place of resistance and untapped creativity.

Latour's definition of actants grants permission to align science and the command, these two expressions of knowledge that undergird social control. Science as an actant does not represent reality more accurately than other knowledge. Latour puts it this way, "'Science' only gives the impression of existing by turning its existence into a



permanent miracle” (1988, 217). Science’s cornering of objective reality derives from the relationships among other actants in a network that uphold its position of authority.

Both expressions, science and the command, set the terms of objective reality and circumscribe experience and behavior. Social and technical structures naturalize explicit points of conflict and embed them in the structure of our experience in ways that make them difficult to notice. Thus we are hard pressed to problematize, politicize or develop a reflexive stance toward these structural elements. The concept of how commands become domesticated answers a hanging question from chapter one about what forces in society determine the conditions for slow violence (Galtung 1969, 171). This naturalized coercion built into the system is the main substance of Mumford’s critique of mechanization in the megamachine.

### ***LOCUS OF POWER: Issuing the Command in Mumford, Canetti and Latour***

The prominent image that social science tends to use as an aggregate entity in society is “an idealized image of the nation state” which “transfigure[s] the role that power plays in the creation and maintenance of the latter” (Árnason 2004, 80). Our three authors evolve the conception of how power supports the megamachine globally, outside the bounds of the state. For Mumford, coercion, divine rule and militarism (later incorporated into the modern state) build capacity for the machine and also increase the speed of technological change (Mumford 1970, 191). Divine kings and other rulers exerted power to scale up the megamachine. This historical example asserts the primacy

of elite human control over technical production. At the same time, Mumford assigns particular qualities to the materials of production that fundamentally change social relationships.

Canetti distinguishes between force and power by describing the role of each in a game of cat and mouse:

The cat uses force to catch the mouse, to seize it, hold it in its claws and ultimately kill it. But while it is **playing** with it another factor is present. It lets it go, allows it to run about a little and even turns its back; and during this time, the mouse is no longer subjected to force. But it is still within the power of the cat and can be caught again. If it gets right away it escapes the cat's sphere of power; but up to the point at which it can no longer be reached, it is still within it.  
(1962, 282)

In the same way domesticated commands extend force in space and time. An individual command is an expression of power that causes stings that make a lasting psychological change in the recipient. Crowds and their fluidity of individual identity and body remove the sting of commands and thus offer a refuge from the exercise of power.

For Latour, actants' power arises only from winning allies, not from an innate inner strength or conviction or orientation (Harman 2009, 20). Power is a result, or Latour might say an artifact, rather than a substance (Harman 2009, 21; 1988). Power is what remains as a consequence the dynamic exchange and tumult of human and non-humans positioning themselves to make meaning at a particular moment in time. From moment to moment the network and our actors are off again making new arrangements, resisting and exerting force instead of wielding power in the conventional sense.

These two visions of power in the megamachine anticipate the claims that Latour

maintains in his work about actants and non-humans. Human control is not the only factor driving the megamachine; a negotiated reality between materials and people gives birth to what others have called hybrids and cyborgs (Callon 2009; Haraway 1991).

## **TRANSFORMATION**

In this final section mapping the components of the megamachine, I consider how each author approaches transformation and the role of technology in change. Technology mediates and amplifies the transition from one state to another, but also, in tension, can transfix the world in a way that stabilizes particular relationships between humans, matter and energy. This paradoxical tension of technology as both driver and inertia in moments of change is present in different degrees among the three authors.

Referring to “progress as science fiction,” Mumford states that “this picture of a steady, persistent, almost inevitable accumulation of improvements reflected not merely the bland optimism of ‘Enlightenment’ intellectuals, but also their self-flattering notions of their own place in human history” (Mumford 1970, 199). As a “progress doctrine” calcified in the early twentieth century, its proponents yoked mechanical and moral progress together, including no affordances for assessing adverse effects or taking steps backward. Mumford’s critique of science in this context can be read as a rejection of the assumptions underlying Karl Marx’s historical materialism. Marx views technological innovation as revolutionary and inevitable. In contrast, the megamachine singles out and diagnoses material production as a diminishment that ignores other possibilities for

human development (Rochberg-Halton 1986, 132). In effect, the logic supporting historical materialism goes against the sort of creative innovation that Mumford is after in his opposition to megatechnics.

In contrast to material production, evolution is “organic life itself,” where mass, energy, and motion serve as the grist for life. Evolution foregrounds active and passive states where life flourishes and withers, multiplies and perishes, rearranging life’s raw materials. Sentience and self-directed activity are among the most important achievements of evolutionary change, lengthening memory, constituting consciousness, and expanding organic potential (Mumford 1967, 31). By juxtaposing a human-driven process of innovation with evolution, Mumford pits two competing visions of transformation head to head and asserts that the evolutionary one, grounded in the elemental interactions of matter, energy and consciousness, redefines and enlarges the notion and landscape of progress. Unique human consciousness that cultivates symbolic extensions of perception through writing, communication, and technologies are at the heart of collective capacities that progress, as defined by the megamachine, ultimately undercuts.

Whereas Mumford holds up symbolic communication as a salutary achievement of evolution, Canetti grounds notions of transformation in an “immanentist’s view” meaning locating change in bodies and in situated space and in direct relation to the material. Symbols give way instead to affective or what Virilio has defined as a ‘logic of speed’ that ignites change in crowds (Brighenti 2011b). Crowds are either open or closed. This simple assertion early in Canetti’s text furnishes the key for where technology

intersects with transformation. Closed crowds place internal limits on their scope and function and don't grow. Open crowds, however, try to expand in an unlimited way everywhere, and are tied strongly to one of the primitive foundations of packs: the impulse to increase.

In the increase pack, however, we have a formation of greater complexity. It is of immense importance, being the specific propelling force behind the spread of men. It has conquered the earth for him and has led to ever richer civilisations [sic]. The full range of its effectiveness has never been properly understood because the concept of propagation has distorted and obscured the actual processes of increase. These can, from the very beginning, only be understood in conjunction with the processes of transformation (1962, 107).

The open crowd is amenable to the progress doctrine and possesses the velocity and determination that give technological innovation the character that Mumford criticizes. A story about aboriginal totemism reveals the dynamics of transformation in the increase pack. Tribes create ritual in which members adopt an identity that is half animal, half human. In this primitive illustration, aboriginals identify and, through ceremony, become half-animals and (sometimes) the plants that the tribe needs to survive. Ritual is the performance of desire for a given resource and the totem is the emblem of a mutual benefit for both human and animal in the relationship.

The product of transformation is something that I propose to call the figure. This is an entity that is not susceptible of further transformations and which manifests itself only after transformation has been completed. Its shape is clear and limited in every respect. It is not a natural object, but a creation of man; it is his escape from the ceaseless flux of transformation. (It should not, incidentally, be confused with the "kinds" or "species" of modern science.)

.... "Thus the earliest figures are representations of the process of transformation, From the unending flux of innumerable possible transformations, one is picked out and given a permanent form. The very process of transformation, or rather a

particular instance of it, is secured forever and thus, in comparison with all those which are excluded, is filled with a special significance. The unchanging double figure of the totem, which contains and affirms the metamorphosis from man into kangaroo and from kangaroo into man, is the earliest and most important of all figures, their prototype." (1962, 373, 374).

The figure fixes a contingent moment in time and captures a snapshot of a process of shape shifting between animal and human. The concept of the figure as fixing a given transformation calls to mind Langdon Winner's (1986) concept of "technology as legislation," where technologies created at a particular time in a particular social and political context ossify those qualities and continue to embody them in future contexts. The tragedy, then, of creating the technological totem is that it fixes a particular contingent relationship between man and nature that then imposes itself on human experience when other referents in this flow of negotiation between human and natural have moved on. And as innovation increases, it is an understatement to say that modern society is replete with these totems, like the hundreds of cable television channels that now create more noise than signal.

The megamachine is a "figure" in the aggregate that has fixed the contemporary sociotechnical arrangement that fuels innovation as we know it such that collective capacities are bent towards particular expressions and ignore others. Canetti asserts that there is not one crowd, but many potential configurations and expressions of the will of crowds that depend upon contingent arrangements with the environment and nature to emerge.

Even as transformation indicates a synergy between humans, animals, and the

material world, both Canetti and Mumford hinge their interpretation on human perception. In contrast, Latour's 'a-human' transformation conceptualizes change that does not depend upon human interpretation. Like Canetti, Latour resists describing transformation as any representation other than those marshaled by actants: "since whatever resists is real, there can be no 'symbolic' to add to the real [...]" (1988, 188). Transformation, known as "translation" in Actor Network Theory, happens when actants negotiate the terms and conditions for garnering attention, influence or significance. In *Pasteurization*, the translation that leads to Pasteur's notoriety centers on a misunderstanding of the interpretation of scientific findings in the lab regarding evidence of "contagious ferment" (1988, 63). Hygienists saw benefit to their cause in becoming Pasteur's boosters.

Technology can be found in a chief activity in translation, what Harman calls "the mediator," responsible for "doing new work on its own to shape the translation of forces from one point of reality to the next" (2009, 15). Extrapolating from this assertion, technology as mediator possesses its own identity and qualities that interact to effect transformations. Latour's representation of translation here and the assertion of the independence of mediators, be they animal vegetable or mineral, is very close to how Mumford represents the rearrangement of components of matter and energy as a consequence of evolution. Latour is more explicit about how the non-human changes the world. His method echoes and extends Mumford's assertions about the transformative power of materials on the human psyche. Transformation is the lynch pin that yokes what I have been building about crowds, non-human actants and the material together to define

the phenomenon of innovation more broadly. Mumford has led me to explore what collective capacities are, what they can do, and how the megamachine leads to a destructive version of innovation defined solely as progress.

## **THE SOFT MEGAMACHINE**

It is useful to place Mumford in conversation with these two authors because each text enriches our understanding of precepts of and alternatives to the megamachine. These additional texts bring forward important elements that constitute a new perspective on collective capacities. My analysis makes more explicit the role of collective capacities that make innovation possible.

Latour emphasizes the importance of (material) non-humans and provides a heuristic and process for pinpointing those influences and interdependencies. Canetti moves the unit of analysis away from the individual and to the collective in a way that breaks with conventional treatments of aggregates. Canetti describes an ontology of crowds that makes way for understanding that there is a multiplicity of types of crowds and crowd behaviors, which the megamachine stifles (McClelland 1989, 302).<sup>6</sup> The synthesis of Canetti's and Latour's thinking as a reinvigoration of the megamachine provides a novel interpretive frame focused on the role of the collective in transformation. This frame repositions the function and meaning of resistance and makes way for alternative interpretations of technological transformation.

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<sup>6</sup> See McClelland here for a description of the critique of Le Bon finding the same crowd everywhere and Canetti's careful Aristotelian parsing of different types of crowds.



Social scientists who analyze power normally think of resistance as a force that acts on the margins or from the “bottom up.” Mumford ends *Pentagon of Power* with the suggestion that in order to thwart the megamachine and begin a new habit people will have to willingly and gradually withdraw and place limits on their participation in the processes that currently support a doctrine of progress. Canetti’s *Crowds* and Latour’s actants together confirm that there are material and affective resources available to fuel the sort of resistance Mumford is thinking about. Both Latour and Canetti think of resistance as an independent force. Latour prefers the term “resistance” over “power” because it describes the action by which an actant (continually) affirms its existence. Crowds are multi-scalar and multi-dimensional and, by providing refuge from commands, demonstrate that resistance is an essential category of human life that exists outside of a strictly political definition (Brighenti 2011a). In other words, resistance is not a marginal activity that precedes a more robust form of revolt, rule, or power. It is what crowds (and in fact) all things do.

Established traditions for examining power in the aggregate, classically, the study of capital and the nation state, have viewed resistance and the embodiment of resistance as occurring outside of institutional, bureaucratic and traditional political structures. If resistance is an essential aspect of all actants it occurs in the context of and also supersedes traditional units of political analysis. Given this alternative view of resistance as an essential quality of being, it follows that the exercise of government through policy interventions, political coalition building and the rule of law has also missed an

opportunity to directly address the elemental version of resistance embedded in collective capacities.

## Chapter 3

### PARTICIPATORY TA AS *BILDUNGSROMAN*

Through an examination of the notion of collective capacities, I have reenergized key concepts drawn from Lewis Mumford's critique of our contemporary sociotechnical arrangements captured in his metaphor of the megamachine. To this end, I have used Latour and Canetti to accentuate and expand upon a model of the nature of collectives: qualities and patterns that emerge from the behavior of groups, societies, systems, and ecologies, collectives of both human and material actors. The influence of collectives, or what I refer to as "sociotechnical crowds", has a unique impact on environments that add up to more than the result of the individual actions of people, famous and not so famous. Mumford's critique is that today collective capacities are shaped solely by epistemic, material and cultural habits that produce the megamachine. I use the conviction that sociotechnical crowds are multiplicities rather than solely megamechanical now to question current practices aimed at mediating technological innovation, namely, technology assessment. I will consider what this concept of sociotechnical crowds with multiple ways of being could mean for the practice of technology assessment.

In this next chapter I am going to argue that the talents of sociotechnical crowds and their multiple capacities are not sufficiently tapped by contemporary TA practice. There are two aspects to my critique on these grounds. First, TA practices, especially those that include public participation remain rare in society and in government (and so are hardly representative 'crowds'). They include only a small number of people at any

given time and they are structured from the top-down, meaning that processes invite expert and public comment on particular scientific and technological topic predetermined by process organizers. Second, the design of TA processes leans most often on rational discourse that privileges specialist knowledge, what Guston (2014, 56) has labeled the BOGASATT model, or ‘bunch of guys sitting around a table’ model. My fundamental critique is that the current way we manage innovation through consultative processes, both expert based as well as those that involve a broader set of citizens, are actually not able to produce results that would take the path of innovation away from one continually shaped by the megamachine. The third and fourth chapters of this dissertation explore further opportunities for governing innovation through the practice of participatory TA. If we hold that collective capacities of sociotechnical crowds are an influential force greater than the sum of individual efforts, wills, hopes and desires, how would we design a more participatory and responsive TA?

To answer this question, I conceptualize the action of pTA as transformational. I model the qualities of emergent technology assessment (ETA) as an intervention modeled on the concept of *bildung*, referred to in literature as a novel of education or formation.

“To undergo *Bildung* is to identify with humanity: a humanity that is itself an ongoing process of self-realization or becoming. An individual's *Bildung* is the echo or anticipatory repetition of humanity's historical movement toward the realization of its ideal potential. Few individuals achieve this degree of acculturation—and in a sense no one achieves it, since *Bildung* is always ongoing, an infinite approach to an ideal—but everyone ought to.”

(Redfield)

It is appropriate to invoke the meaning of *bildung* as we turn next to an analysis of practice that takes Mumford's cautionary tale of the megamachine and its relationship to the crowd and its collective capacities and behaviors into account. In literature, the *bildungsroman*, a novel of transformation, tells the story of maturation. It is a story that aligns the inner self with the outer society and, importantly, the material and the technologies that fix transformations. "The very idealism of the genre in its classical form offers a model of how to think and write about unacknowledged, suffering subjectivity while at the same time entering a productive, if by no means unproblematic, relationship with existing social and moral conditions." (Schellinger, Hudson, and Rijsberman 1998). This notion of formation aligns with interpretations of technology assessment as social learning (Barber 1984; Bull, Petts, and Evans 2008; Nordmann and Schwarz 2010). "What is at stake is a process, within which inner and outer combine fruitfully, without one being subordinated to the other" (Schellinger, Hudson, and Rijsberman 1998). If we wish to turn from an artifact focused pTA, we might take care to consider the *bildung* focused on collective transformation in society.

Having examined the differences in the descriptions of transformation in Mumford, Canetti and Latour and the role of technology in state change, I define and bound what I mean by formal TA and then lay out the criticisms that have been meted out to the forms of TA that today exist, paying particular attention to those that involve public participation, or participatory technology assessment (pTA). Though pTA greatly expands the TA horizon to include diverse citizens and knowledge, the modus operandi for the conduct of these events adheres to many of the rigid strictures of expert-based TA.

pTA organizers typically stick to science-informed, heavily structured formats for obtaining public feedback as a part of deliberative exercises. Affective, material, and experiential knowledge that might reveal and make relevant other kinds of collective capacities and emergent concerns and knowledge are rarely included in pTA designs. I argue that contemporary pTA design and practices privilege institutions, knowledge, and regimentation that reproduce conditions under the megamachine. In the three empirical cases I will examine in this chapter, I visit three pTA processes that experiment with methods and strategies for engaging publics. I will show that the idea of ‘self-fashioning’ in concert with “external circumstance” in the literary convention of the *bildungsroman* is suggestive of the way collective capacities could provide a starting place for guiding innovation.

## **TECHNOLOGY ASSESSMENT AND THE DELIBERATIVE TURN**

By technology assessment (TA) I mean formal practices that engage experts and sometimes lay people in the evaluation of issues associated with complex scientific and technical topics. TA techniques encompass forecasting technology impacts and side effects, assessment and communication of risk, promotion of innovation, social shaping of technology, improving the legitimacy of decisions on technology, mediating in technological conflicts, and observing sustainability (Grunwald 2013). Organizers of TA undertake it with the aim of crafting policy-relevant recommendations and designing interventions that can steer technological innovation in particular directions.

In the wake of prolific scientific and technological innovations spurred by investments in industrial and military institution building during World War I and II, policymakers in both national and international contexts debated mechanisms for translating investments in science and engineering into public benefits. In 1972, the U.S. Congress institutionalized one such mechanism by forming the Office of Technology Assessment (OTA). OTA anchored the ideas of science and technology for policy and policy for science into the practices of an organization functioning directly in the service of Congress. This institutionalization of Science and Technology (S&T) governance allowed for the development of practices and procedures descriptions of what is now known as TA (Grunwald 2013). The institutionalization of S&T advice for decision-making through OTA and later the European Parliamentary Technology Assessment (EPTA) in 1990, prompted members of the U.S. Congress, European Parliaments, government agencies, think tanks such as the Rathenau Institute (formed just after OTA in 1978) and their consultants to compose a number of manuals and overviews devoted to the design and conduct of TA (National Academy of Sciences (U.S.). 1969; Rip, Misa, and Schot 1995; Grin 1997; Dietz and Stern 2009).

Several conceptual models evolved in concert with TA procedures in the late 1980s and early 1990s including Interactive TA (ITA) and Constructive TA (CTA). A decade later as renewed funding priorities included the social sciences in the support for emerging research enterprises such as the human genome and nanotechnology, two new TA concepts expressly addressed a temporal dimension. Real Time Technology Assessment (RTTA) and Anticipatory Governance, address not only the question of who

is at the table in TA, but also deal with the policy relevance of the outcomes as a function of timeliness and frequency (Barben 2013; Grin and van de Graaf 1996; Guston and Sarewitz 2002; Rip, Misa, and Schot 1995; Marris, Joly, and Rip 2008). Proponents of ITA take the position that to influence development paths, TA must engage various actors in the development process (Grin 1997, 12). In contrast, organizers of CTA do not always involve direct stakeholders in the development process. CTA aims to influence the conceptualization and implementation of new technologies through dialog and exchange with expanded audiences. Still other models seek to instantiate reflexive techniques for RTTA: institutional and participatory practices that build the habit of a continual checking in on the fit and function of technological systems (Guston and Sarewitz 2002). RTTA's attention to the velocity of innovation addresses concerns about the dynamics of novel and emerging technologies. RTTA notions guide the design of a multipronged research framework known as Anticipatory Governance (Barben 2013) that models how assessment can take into account foresight, interdisciplinary integration and public engagement in concert.

The US science policy world uses the moniker "Jeffersonian Science" to refer to research that serves a dual purpose: furthering basic knowledge, but in the service of societal problems. Scholars and analysts have cultivated this argument to motivate particular federal R&D investments in scientific research.<sup>7</sup> Similar arguments for influencing the trajectory and composition of technological development have emerged in camps concerned with usability, sustainability, and environmental impacts. Among these

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<sup>7</sup> See (Holton 2011).



is the idea of participatory technology assessment (pTA), meaning a collection of (typically formal) strategies for engaging citizens more directly in this process. pTA as a practice is embedded in an intellectual concern discussed by science and technology scholars about how much the public should - or could - be involved in technical development and decision-making. This broader concern is known as public participation or public engagement.<sup>8</sup>

Involving publics in governing complex systems in practice speaks to a growing concern about whether human societies possess the capacity for wholesale transformations of socio-technical relationships. News from many camps suggests that we face broad systemic challenges to stability in the environment, climate, urban settings, and institutions that depend upon complex technological regimes to perpetuate themselves. Can we not only mitigate the impacts of innovation with engagement, but can we change their direction? Can we impose limits that can be effectively taken up in practice, by institutions, by way of governance, meaning a distributed reflexive decision making environment? Does democratic participation in S&T issues precipitate change, or do the challenges posed by existing sociotechnical relationships mean that engagement is merely further indoctrination? Here I review critiques of pTA as cooptation and indoctrination; pTA and the role of experts; barriers to connecting pTA to formal policy processes; pTA as a capacity building process; and the degree of reflexivity in contemporary practices.

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<sup>8</sup> These concerns are taken up in the science policy literature. They are operative in science communication as well.

### ***Cooptation and Indoctrination***

Particularly in the United States, critics of pTA have argued that these processes merely condition citizens to accept a new technological reality where the process is driven by scientific technological and power elites. TA in this light rationalizes central structural features of capitalist society and conceals the basis of legitimation through fundamental structures (Bereano 1997, 169; Wynne 1975). One example in recent US history involves the development of ethics panels and public forums associated with research and development involving the human genome. Since the initial federal funding in 1990, the Ethical Legal and Social Dimensions (ELSI) program housed in the National Institutes of Health and the Department of Energy has received 3–5% of the total budget for R&D associated with human genetics (Fisher 2005; Juengst 1996). Some have called the program a failure because of its inability impact regulatory regimes (Kitcher 2001, 189). Kelly has argued that institutionalized ethics programs by their design maintain the status quo, offering an outlet for public concerns but “protecting the autonomy of science to a greater extent than might be possible through strictly legislative processes or through less stable and more open mechanisms for including publics in science governance” (Kelly 2003, 356). Institutional constraints on independent pTA include scope of individual interests, market externalities, competitive pressures, contraction of goals, jurisdictional limitations, representation of affected interests, coordination and focusing of relevant effort (Dietz and Stern 2009). Critics of participatory ELSI activities describe the “path dependencies” of *social* technologies with their rhetorical shapes preordained by institutional and financial dependencies. For these scholars (Wynne 2006; Wynne

2014), participation is yoked to a given institutionalized mission, often one of unbridled innovation.

In contrast, however, others have argued that programmatic design, funding structure, organizational and institutional changes can be effective in giving public input independence and diagnostic weight in a portfolio of TA activities. Bimber and Guston (1997) examine the institutional context for TA and how its techniques can be adapted within institutional frameworks to best have impact on national policy. Their study compares the activities of OTA in the US with other national and institutional TA activities. The comparison allows for greater reflection on the OTA model. Authors propose that a wider range of (European) models could refresh TA in the US context moving forward. A recent review of a variety of pTA models asserts that there is significant variation in the uptake of pTA activities in different institutional settings and less rigidly defined “forms of collective enterprise” (Bickerstaff et al. 2010, 494). Rather than suffering from a deterministic monoculture, pTA in its many forms possesses the potential for meaningful influence in a variety of formal and informal societal settings.

### *Expertise*

Theories of the contemporary risk society suggest that scientific expertise is facing a problem of legitimacy (Lövbrand, Pielke, and Beck 2011). Paradoxically, however, broad swaths of the scientific research and the bulk of applied technological development occur in the domain of experts with very few available mechanisms for public comment. If pTA is meant to incorporate broader public engagement into the R&D

process, then it must confront both theoretical and practical questions about the balance of power within S&T governance with respect to experts. Ezrahi, Brown and others (2009; 1990) discuss the affinities between science, rational decision-making, and democratic principles. These authors demonstrate how science is bound up in the contemporary cultural process in liberal democratic societies. Due to this theorized importance of science in democratic theory and, subsequently, at the base of institutionalized policies about the governance of S&T, the role of experts is meant to bolster democratic forms of governance. This is borne out in the literature on participation in several ways: one is largely epistemic and the other concerns power dynamics in society, institutions and governance.

The pTA process itself, taking as its subject tools, systems and environments that exist because of the exacting work of scientists and engineers, presupposes the salience of specialized information and/or the role of technically trained advisors in the decision-making process. In short, given that pTA is a process intended to provide broad public comment on the fruits of the work of specialists, can the process of involving non-experts produce meaningful information without the presence of specific expertise on the topic in question?

Some say that the public is not adequately informed and therefore cannot participate in dialog. Collins and Evans have argued that the public has insufficient expertise to add to science and TAs (2002, 253). Because individual non-experts are unprepared, participatory processes themselves suffer from hierarchical power relations among the actors involved (Beck 1992; Funtowicz and Ravetz 1992; Lengwiler 2008,

197; Winner 1978). In this sense, power differentials stem from knowledge imbalances. The remedy for this, popularly, involves efforts to increase the public's knowledge about science in order to correct those knowledge imbalances and level the playing field to enable democratic participation.

The other significant area that attracts skeptics of pTA concerns the institutional positioning and narrow mission of pTA with respect to expertise and efficiency. This strand also has to do with the power differential between experts and the lay public. This differential lies more in the framing and structure of the exercise than in knowledge differences (Bickerstaff et al. 2010). The question here has to do with whether or not recommendations by citizens can evolve the R&D process overall, or in a more narrow sense, have an observable impact on the innovation process. This impact could be felt either before a new material or product enters the market, or as a component of the policymaking or regulatory process. Does pTA involving lay citizens have sufficient currency in processes normally facilitated and overseen by experts or professionals? Bereano (1997) asks whether striving for efficient, cost effective decision-making in scientific and technical areas compromises a commitment to a broad democratic and public debate about these issues through participatory mechanisms.

I highlight the contradiction and propose that this aim in TA perpetuates control of scientific and technological futures by an expert elite. This review of US participatory activities also speaks to the quality of participatory exercises by invoking Arnstein's ladder of participation and arguing that most formal pTA is merely consultative. Scholars interested in questions of equity suggest that these forums preserve and strengthen bias

against minority and underserved groups (Mendelberg 2002; Traulsen 1993). In the case of these two types of criticism about knowledge and pTA structure, there are several thoughtful rejoinders that signal pTA design in some quarters has been quite reflexive.

There are several models that have taken power imbalances into account, leaning on the concept of “co-production” of knowledge or of decision-making processes as the focus of participation. Epstein addresses epistemic differentials in his study of the development of expertise among AIDS patient activists and their influence in the treatment and regulation of medicines for the treatment of the disease (1996). This work highlights the acquisition of expert knowledge not as a consequence of arduous professional or academic training, but instead, activists “get up to speed” when knowledge is needed to have their issues heard. In this view, the public acquires what it needs to know to play at the point when groups mobilize around technoscientific issues, utilizing legal avenues for opening debate. Others have documented similar cases of lay empowerment through the acquisition of specialist knowledge and have argued that increasing public participation could in fact lead to a diminished role of experts in the production of knowledge and social order (Jasanoff 2005). This work aligns with the conventional notion that the public needs to understand something about S&T in order to participate, and acknowledges the role of specialist knowledge in legitimating previously marginalized actors.

Other notable work makes a case for contextual knowledge as not only valid but also exceedingly valuable to for the purposes of TA. The oft-cited illustration case that demonstrates the value of lay knowledge occurs in Wynne’s (1996) study of Cumbrian

sheep farmers who correctly identify a source of radioactive contamination in their fields following the Chernobyl nuclear accident contra the data of experts. The object lesson here is that lay knowledge and ground truth can trump expertise. This thread aligns with an argument for public engagement rather than public understanding of science (Burgess 2014; Irwin 2014; Jasanoff 2005) and a focus on quality knowledge, rather than efficiency, exactness, or precision for decision-making (Luks 1999). Lay knowledge takes many forms and combines and contextualizes specialist concerns in ways that are crucial for addressing complex and interconnected scientific and technological landscapes.

As an antidote to this tension between the efficacy of expert assessors and lay contributors to TA, some theoreticians propose a blend, arguing that the combination aids in risk assessment and mitigation of uncertainty. Callon, for example, proposes pTA as a hybrid forum. Callon defines hybrid forums as controversies that take place in public spaces "where groups can come together to discuss the technical options involving the collective, experts, lay people and stakeholders are involved" (2009, 18). Formal meeting designs that take this perspective into account include European Constructive Technology Assessment (CTA), which has at its center an idea of the co-construction of knowledge and mutual learning and builds this in as a consideration in the design of pTA (Grin and van de Graaf 1996; Grin 1997). Model design for practitioner communities that factor in opportunities for mutual learning and co-construction confront directly the critique that institutional and programmatic constraints can also perpetuate a power imbalance in pTA between experts and lay people.

### ***Policy Impact***

pTA that is policy relevant must respond not only to issues of the day, but also to institutional parameters that constitute the intersection of many vectors: scope of individual interests, market externalities, competitive pressures, contraction of goals, jurisdictional limitations, representation of affected interests, issues with coordination and focusing of relevant effort (National Academy of Sciences (U.S.) et al. 1969). Institutionalizing TA with appropriate participatory components is a rational approach to the issue of timeliness. Agency staff can mediate and modulate the relationship between participants and the constraints of agency reporting when they are the hosts and architects of public engagement mechanisms.

Between 1972 and 1975, the US Office of Technology Assessment served such a function for the US Congress, but did little to develop citizen participation as part of the mix. Even given the explicit TA mission, institutional ties, and command of relevant expertise, OTA reports were not always able to keep up with the political cycle at particular times (Bimber 1996; Bimber and Guston 1997). More recently, in November 2008, Congress asked the General Accounting Office to establish a permanent technology assessment function. Its work on a climate engineering report is now complete, but progress was ponderous, confirming this criticism of the OTA expert process (Sclove 2010, 19; “U.S. GAO - Technology Assessment: Climate Engineering: Technical Status, Future Directions, and Potential Responses” 2011, 19). While participatory TA models have gained traction internationally, they remain relatively rare in the United States



(Guston 1999; Guston 2014). In a recent report for the Woodrow Wilson Center for International Scholars program in Science and Technology Innovation, Sclove (2010, 38) explores alternative models for situating pTA outside federal government and proposes an institutional network model. Regardless of the locus of the program, the question remains: can pTA be done rapidly enough to be responsive to political cycles and to systemic changes using formal methods of governance? Scholars of formal pTA agree that organizing deliberations is ideal when there is a ready, willing, and receptive client wishing to know the public's views, thus matching up pTA to dynamism is particularly relevant for policy practitioners. pTA literature that speaks to this concern takes two forms. The first believes that responsiveness can be optimized by issue selection and the second has to do with pTA strategies for practice that are attentive to responsiveness, topic, cost, and timeliness.

In the first case, scholars argue that the timing of a deliberative exercise in the development of a particular S&T issue is key. The NSF Centers of Nanotechnology in Society at Arizona State University and UC Santa Barbara receive federal funding to investigate the human dimensions of nanotechnology and emerging technologies about which the public has little knowledge. Project coordinators presume that facilitating public feedback at this moment in the unfolding of innovation in nanoscience offers a better chance of influencing the direction of development (Guston 2008). In many cases, pTA on emerging technologies like nano can happen in advance of direct need for policy input – regulatory mechanisms and other formal decision making may be in the near future, but not already upon us. pTA in this context can be less “just in time” and more

“anticipatory” in nature. Public engagement with an emerging issue can also sidestep some of the problems that occur with debate over well-worn tropes. Climate change, stem cell research, and choices over reproductive rights are tougher topics to workshop (in the United States) because the issues and by cooptation, the science, have become polarized.

Other strategies for confronting the issues of timeliness include integrating technology use into the deliberative process. Several multi-site pTAs in recent years have experimented with uses of social media and online forums in an effort to scale the process and make it appropriate for participation in larger numbers over multiple sites, to reduce costs and to render a more agile process (Delborne et al. 2011; Selin and Hudson 2010). Evaluations of these experiments suggest that biases in the diversity of participants and power dynamics that mimic face-to-face hierarchical dynamics are present in virtual communication forms for deliberation and may be more difficult to mediate. In the National Citizen’s Technology Forum (NCTF), a multi-site consensus conference about human enhancement coordinated under the NSF funded Center for Nanotechnology in Society at Arizona State University, participants queried about the (CMC) approach reported that the online experience “lacked coherence, limited the panelists’ autonomy, and failed to inspire high levels of engagement and attention to the process” (Delborne et al. 2011, 15). Technological convenience sacrifices desirable qualities in the participant experience. An earlier European transnational consensus conference on brain science called *Meeting of the Minds* similarly used technology to scale the event and to reach multilingual audiences. Subsequent assessment of the cost and benefit of conducting large scale technology enhanced consultation recommends

against a proliferation of lower cost technology enhanced exercises, arguing that it “will lower citizens’, policy-makers’ and the media’s interest, “in favor of an institutionalized annual event coinciding with a European Council meeting, and focused on a “salient, controversial issue, fundamental for the EU’s future” (Boucher 2009, 18). The issue of an encumbered, costly and plodding process is a serious barrier to policy impact. The literature shows that experimentation is occurring at national and transnational levels, but there are few unqualified successes. The challenges are hydra-headed, in that topics must be selected in a timely manner, organizers should address issue polarization if it is present, frame the issue such that it is policy relevant, organize processes that are expedient to conduct, and ensure that reporting is appropriately packaged and marketed.

### ***Risk and Uncertainty***

Theorists of risk have argued that participation matters more in the context of S&T policy in a complex technical and knowledge production environment. Ulrich Beck describes risk in modern life as a progression of three stages: premodernity, simple modernity and reflexive modernity. Beck (1992) characterizes the hallmark of reflexive modernity, the final stage, as an inability to localize risk in time or space. In other words, rational scientific techniques for discovering, bounding, and describing risk are thwarted by the sheer diffusion and complexity of scientific and technical systems and their impacts (the half life of nuclear waste materials is an example). Functowitz and Ravitz (1992) in turn define a “post normal science” as a consequence of this risk society: a science that should be steered both directly and indirectly by broader society to produce

quality outcomes. In the context of this theory of risk, participation becomes a way to establish reflexive techniques for RTTA, institutional and participatory practices that build the habit of a continual checking in on the fit and function of technological systems (Guston and Sarewitz 2002). RTTA is a kind of instrumentalization of what political scientist, Charles Lindblom (1990), calls a “self-directing society,” one that encourages a public habit of “probing”. “Technologies of humility,” or “methods... that try to come to grips with the ragged fringes of human understanding – the unknown, the uncertain, the ambiguous, and the uncontrollable,” will complement predictive approaches and make more explicit the normative dimensions of S&T issues, as well as the areas of uncertainty (Jasanoff 2003, 227). This sort of societal vigilance embodies liberal democratic norms and presumes that mainstreamed pTA could provide an avenue for rapid adaptation when unexpected things transpire. The question is whether pTA in its current form can actually make a dent in these sorts of systemic quandaries.

pTA designs have emerged in part out of theorizing small group deliberation as a tool for invigorating the democratic process. Democratic theorist Dahl introduced the idea of a “minipopulous” --a demographically representative group of perhaps 1000 people-- who could, aided by communications technologies, deliberate about a major issue of concern for a year and announce its recommendations. Experts, administrators and researchers would be available to the group to assist the group’s process (Dahl 1989, 342). Theorists and practitioners have argued that minipublics can make policy directly, can be taken up readily in the policy process and can generate informed public opinion. They may also “market-test” certain proposals, legitimize public policies, and strengthen

trust and build support for policies, provide popular oversight, and can resist co-option that can occur with interest and stakeholder involvement (Goodin and Dryzek 2006). In practice, however, pTA does not resemble the theorized ideal. This is so in part because of the relative rarity of support for and occurrence of citizen dialog on issues of scientific and technical concern in proximity to decision-making.

In a review of empirical work on deliberative activities, Carpini, Cook and Jacobs air their “suspicion that public deliberation is so infrequent, unrepresentative, subject to conscious manipulation and unconscious bias, and disconnected from actual decision making as to make it at best an impractical mechanism for determining the public will, and at worst misleading or dangerous” (2004, 321). There are relatively few citizen consultations with true leverage to influence either the innovation stream or the policy and regulation of new developments. In addition, the number of participants in a given consultation is relatively few. Some argue that these small numbers cannot speak for a broader public, nor can a given consultation take advantage of a broad enough swath of public knowledge to be salient in the face of unpredictable futures.<sup>9</sup>

Lastly, pTA events are often focused on particular technologies and thus are too narrow. Engagement designed around single technologies cannot deal adequately with systemic changes that turn out to be the culprit in many surprise accidents that Perrow (1984) has argued, are now the norm for complex, interconnected systems. Practice and

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<sup>9</sup> In this same vein, evaluators of existing processes question whether pTA develops social capital among those who do participate. Research on small group deliberative exercises tends to focus on the impact of a given activity on participant learning and engagement with related civic issues. Zimmerman and Rappaport (1988) link participation with a psychological index covering personality, psychological and cognitive measures of social capital. Researchers found that citizens actively engaged in a spectrum of community activities scored higher in the indices for empowerment.

institutionally oriented analysts charge that there is a failure of existing processes to give weight to the full range of concerns is due to the lack of representation in current processes of decision-making (Dietz and Stern 2009). Current pTA designs fall short of addressing some of the key theorized issues with risk and uncertainty because of their limited number of representative participants, narrow issue scope.

### ***Reflexivity***

Criticisms of the pTA process and design take many forms. Some analysts are concerned that public deliberation is little more than another enclave of “gated democracy” --a practice reserved for the same group of affluent (North Americans) who disproportionately deploy their checkbooks to lure candidates to their favorite positions or who are already well-endowed with social capital (Carpini, Cook, and Jacobs 2004). Others critique the narrow focus on particular technologies, or agendas. In a recent opinion piece in *Nature Nanotechnology*, Wickson, Delgado and Kjølberg note that the dominant mode for public engagement in nanotechnology is based on inviting selected disinterested individuals to participate in “short-term, preframed exercises aimed at achieving product acceptance and/or political legitimacy” (2010, 758). Authors argue that this narrow, technology-specific approach treats the public either as “laity” or as “consumers,” not as citizens who must not only consider the impacts of science and technology on their own lives but also must see themselves as representatives evaluating S&T on behalf of their communities. Brown has seconded this critique of science and technology assessment more broadly to suggest that lay participation in TA merely

enrolls the public in technocratic policymaking and rarely enacts significant changes to the existing governance structure (2009).

Still others find the expectation of consensus as a function of deliberative activities lacking. Consensus is not the only model that guides talk in pTA, but it is a prominent one used to establish closure and, by association, agreement on specific recommendations that are actionable and policy focused. Horst (2010) argues for "agnostic pluralism" in place of consensus - acknowledging that antagonism and conflict are unavoidable and possibly a good sign that democracy is working. Coming to consensus closes down inquiry and leaves many path dependencies unexplored.

Taken together, literature critical of elements of pTA design call out features that (ironically) are in place in contemporary practice because of the desire by conveners to register true impact on technology governance. Identified clients, well selected participants and experts, targeted agendas and consensus around actionable recommendations have evolved in a number of national contexts for the very purpose of developing useful and policy relevant models. To address these criticisms, designers of engagement activities might imagine ways to get away from instrumentalized models. How might social capacity for self-organized, participation that emerges when conscious and conscientious citizens notice that a given situation requires reflection in an ongoing basis be scaffolded?

Recent political science literature on democratic practice describes the range of legislatively sponsored deliberation in national governments. Dryzek picks up on Habermas' (1989) and Benhabib's (1996) notion of the influence of the public sphere on

democracy. Dryzek asserts that the vigor of the public sphere may be especially important in countries where government does not create formal legislative support for public debate. In effect, he argues that without formal supports for public exchange of ideas and even disagreement that enliven politics and policymaking, “nontraditional institutional forms” like governance networks can emerge and supersede the authority of nation states (Dryzek 2009). In this space, public and private entities, non-governmental organizations, social movements and both formal and informal person-to-person interactions shape liberal democratic politics, thereby constituting a kind of metagovernance (Sorensen 2006). During the same period that marked the growth of institutional forms and practices of TA that I describe at the outset of this chapter, evidence of the presence and influence of metagovernance around the world has grown and evolved as evidenced in the exponential growth of the global network of NGOs and formalized IGOS and other transnational networks in civil society. Castells (2000) captures this trend in civil society and puts it into context alongside the forces of a globalized free market in his work on network societies. I invoke this broader picture here to position the development of TA theory and practice as a case study in S&T governance that has been and continues to be sensitive to this broader evolution of the public sphere as an important factor in governance.

In effect, technology assessment practices are one among many ‘social technologies’ that are being prototyped, tested, remade, and discarded in this metamorphosis of the public sphere we are living through. Mumford would link this trend to his speculation about the drivers of what he called the “biotechnic” age. What



distinguishes TA practices as social technologies is the degree to which TA enrolls foundational sources of expertise that are responsible for the dominant innovation culture: scientists, engineers, and other professionals who give shape to megatechnics.

In establishing TA as a tool of governance networks, I follow Parkinson and Mansbridge's lead in suggesting that in order to think about designing TA interventions that support deliberative democratic aims, one must take a systemic approach (2012). Public engagement will delineate clearly the places where risk and uncertainty lie. This sort of societal vigilance embodies liberal democratic norms and presumes that pTA embedded in civic life and in informal learning would open the possibility for rapid adaptation when unexpected discoveries, events, side effects, or spill-overs transpire as a consequence of scientific and technological change. Further, pTA can provide tools for future oriented, or anticipatory, inquiry through the use of scenario techniques (Selin 2008a; Selin 2008b). pTA in these terms supports civic resilience: the ability to recover from or adjust in the face of change.

Theorists speculate that involving the public more closely in assessing the risks, benefits and future ramifications associated with technological systems is necessary because wide ranging impacts of these systems create a different landscape for understanding risk, conceptualizing and governing uncertainty, and aligning scientific and technological innovation with public needs in a way that maintains collective trust and accountability. pTA combines with material deliberation and scenario development techniques provide tools for prospective inquiry (Selin 2008a; Selin 2008b). The three

case studies included in this chapter look into experimental designs and performances of TA. I approach these three cases from the perspective that a focus on the characteristics and components of collective human capacities in sociotechnical systems, rather than on the social dimensions of a particular technological trajectory should guide the design and performance of TA as a governance mechanism for innovation. I note where these three cases adhere to and diverge from conventional pTA models.

Here are three cases of TA that employ experimental participatory methods outside a formal TA scenario. These interventions are situated in or associated with informal science learning contexts. Academic institutions or science museums host them. This empirical work confronts the narrow, instrumentalized definition in STS literature on citizen participation in TA of how participation democratizes TA in government and institutional contexts. My analysis accounts for materiality and affect in different forms for all three cases. Davies et al. (2012, 353) has dubbed these types of interventions “material deliberation,” as “processes of deliberation and citizen engagement which incorporate an awareness, openness or sensitivity to non-traditional modes of deliberative interaction, including, but not confined to, the sonorous (music, singing, laughter, noise), the discursive (gossip, storytelling, anecdote, polemic, drama), the material (objects, bodies, sites, places) and the affective (hate, love, fear, attachment, nostalgia, intuition, pleasure).” Elements in each of the cases attend to the situated nature of participant experience, deliberative or not, as embedded in particular spaces, material configurations, and in time.

As I established in Chapter Two in the discussion of Mumford's materials, the physical presence of technologies and the resulting resistance of collective capacities changes the nature of the conversation and the quality of both self-knowledge and collective understandings of political and civic life. Likewise, pTA processes should be attentive to and allow citizens to articulate the collective habits, behaviors and creativity that can be expressed as "tacit knowledge," knowledge that factors in to the successful orientation of a given decision, whether or not it involves a technological solution.

## **METHODS AND APPROACH**

If I truly am invested in getting to the bottom of what is interesting about the collective capacities of sociotechnical crowds, I must take seriously the charge that my own social science methods might in and of themselves block the way. I preface my discussion of method with the admonition that method and theory are at odds in an important sense for my project. I invoke here Wolin's classic piece "Political Theory as a Vocation" (1969), which lays out a serious concern regarding the deflation of theory in favor of explanatory methods. The grounds for his worry about the rise of empirically based social scientific analysis at the expense of historical theorizing bears an uncanny resemblance to those in Mumford's critique of megatechnics:

In a fundamental sense, our world has become as perhaps no previous world has, the product of design, the product of theories about human structures deliberately created rather than historically articulated. But in another sense, the embodiment of theory in the world has resulted in a world impervious to theory. The giant, routinized structures defy fundamental alteration and, at the same time, display an unchallengeable legitimacy, for the rational, scientific, and technological principles on which they are based seem in perfect accord with an age committed

to science, rationalism, and technology.... Theory, as Hegel has foreseen, must take the form of ‘explanation’” (Wolin 1969, 1081).

While I accept the mode of empirically based inquiry as part of my professional identity, I also acknowledge that to better apprehend the shape and talents of sociotechnical crowds I must be attentive to modes of inquiry that set the conditions for the sort of theorizing that Wolin is talking about.

Thus, in the first part of this dissertation I use the humanist’s gaze through of literary analysis to illuminate themes in Mumford’s megamachine. I place these themes in conversation with the writings of Bruno Latour and Elias Canetti. By following the narratives and paths that others have wrought in myth, fiction, history, and STS theory, I have endeavored to make out and elaborate on what Mumford means by collective capacities that drive material innovation. This theorizing leads me to ask how governance might work if sociotechnical crowds are a genuine entity in the world. Just as previously unseen microbes, once detected, order the world in particular ways. If unique aggregate effects of sociotechnical crowds exist, these too order the real. These crowds make room for themselves in a way that has not been detected directly by empirical probing. I now take the theoretical assertions about sociotechnical crowds as a lens for empirical analysis. In specific, I study three cases of experimental technology assessment with small group deliberation as a feature of a specific, if rare, model of technology governance. In the final chapter I look at the epistemology that a new environmental social movement is developing as a way to set the stage for governance activities.

**Table 1: Empirical cases**

<b>Field Research component</b>	<p><b>Case 1: Endless Table</b> at Museum of Science Boston a public engagement activity at an outdoor public festival focused on food policy</p>	<p><b>Case 2: Futurescape City Tours</b>, a three meeting dialog featuring a walking tour and participant photography</p>	<p><b>Case 3: Finding Futures</b>, a walking tour with participant photographers</p>	<p><b>Case 4: Transition Initiative</b>, Interviews with the US and UK leadership of community groups participating in a new environmental social movement</p>
Analytic Focus and Key Features	<p><b>PTA as event</b> Institutional/network settings and capacities for conducting pTA</p>	<p><b>PTA as Wayfinding</b> Intervention that interjects materiality and experiential learning as input to deliberative processes</p>	<p><b>PTA as propaganda</b> Intervention that allows publics to identify concerns</p>	<p>Epistemologies motivating participation in the movement</p>
Sites and Contacts	<p>Museum of Science Boston, outdoor festival. Contact: organizer David Sittenfeld, Manager, Forums Program</p>	<p>CNS-ASU Center for Nanotechnology in Society. Contact: Dr. Cynthia Selin, RTTA 3 lead</p>	<p>‘Science in a Digital Society’ conference in Lisbon, Portugal and workshop participant groups</p>	<p>Snowball sampling beginning with UK research contacts and US participant observation in Tucson, AZ and Amherst, MA</p>
Methods	<p>Between 8 and 20 <b>semi-structured interviews</b> with expert invitees, and conversation facilitators</p>	<p><b>Field observation</b> with citizen participants, expert invitees, and event organizers</p>	<p><b>Media analysis</b>: image and text analysis of photographs taken by participants at 2 workshops</p>	<p><b>Semi-structured interviews</b> with 22 individuals who organize TI groups in 10 communities with active Transition initiatives: six in the UK and four in the US.</p>

Here I summarize the nature of the three pTA cases and relate methods I selected to look at each one intensively [see **Table 1** for an overview]. For each case I describe the extent of my participant observations during the pTA events. Where I conducted individual interviews, I talk about how I selected or recruited study participants. In the cases where I consulted primary source materials such as documents, publications or web-based or digital resources, I make these known. In the narrative of each case that follows I provide further detail about the methods of analysis that lead to my results that are specific to each case.

This marriage of my theory that latent talents of sociotechnical crowds exist to empirical work on small group deliberation that attempts to access the multiplicities of crowds may fit only in the sense of “looking through a glass darkly”.<sup>10</sup> I do not select these cases as a way to verify my theorized behavior of crowds; the small group minipublics in my cases of pTA are not exemplars of crowds by any means. I ask instead how can interventions that encourage the governance of innovation be designed differently if we hold that collective capacities of sociotechnical crowds are an influential force greater than the sum of individual efforts, wills, hopes and desires?

Overall, and perhaps paradoxical to my positioning as a theorist, I take the stance of the participant observer in this empirical work. Participant observation is qualitative research that seeks to understand the world through the co-creation of meaning in close proximity to and in partnership with research participants. This mode emphasizes

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<sup>10</sup> A reference a biblical passage from 1 Corinthians 13:12 that signifies the imperfection of knowledge and the distortion of perception by way of inquiry through the material, in this case a mirror.

collective inquiry and experimentation grounded in experience and social history. It puts these in context with the researcher's own perceptions, intuitions and opinions.

My role as a researcher in these four cases is discrete in that I do not organize any of the events, nor did I seek to enact further community change in partnership with the pTA participants as my subjects. However, my identity as an STS scholar of public engagement more broadly is as a Participant Action Researcher (PAR). I organize and manage pTA processes as well as research them with the goal of advancing the practice and co-creating benefit for the people and communities who engage. PAR seeks to bring technique and theory into close conversation with a high level of reflexivity that we undertake research in a climate of high uncertainty and risk (Chevalier and Buckles 2012). PAR also seeks to situate method squarely in experience. Taking these principles from PAR involves me as a researcher in the same space as the experimental technology assessment processes I study that seek to incorporate material deliberation. These qualitative methods, while still seeking to describe the world empirically, come closer than others I might have selected to making room for the possibility of multiplicities and for uncertainty. The possibility for things to be otherwise is the factor Wolin claims will otherwise be edged out by the bulk of methodizing.

**Case one, pTA as event at the Endless Table**, is an analysis of a public engagement activity at an outdoor festival focused on food policy and hosted by the Museum of Science Boston. I select it to answer the question “what institutional/network settings can best support pTA interventions that take the megamachine into account and build deliberative democratic capacities?” The methods I use here include 1) participant

observation of a day-long “Let’s Talk About Food Festival” and its deliberative experiment called “The Endless Table”. 2) I conducted post-event telephone interviews with eight invited attendees, two scientists and six conversation facilitators; **Appendix A** contains the question instrument. 3) In addition, I examined email invitations and printed information materials that were provided to participants, experts, and facilitators with attention to how the information materials revealed event organizers’ pTA design. I include several of these materials as figures in the text.

**Case two: pTA as wayfinding – CNS-ASU Futurescape City Tours Pilot,** centers on the analysis of pTA designed as a walking tour to discover hidden technological infrastructure in the city of Phoenix, Arizona. This case addresses the question “how do experiential methods that take the affective and material into account affect deliberative processes in pTA?” Participants in the study include the organizers and recruited group of fifteen citizen participants who had elected to take part in the tours. Here I 1) participated and recorded personal notes on observations and personal conversations during the day-long walking tour and the culminating meeting. 2) I examined photos participants took during the tour as the subject of small group discussion about the past, present and future of technologies in Phoenix, AZ. 3) I also examined the artifacts of the tour that were inscribed or collected and arranged by participants during the second and third meetings including tour notebooks, photographs, and table notes and photo ensembles from the final discussion and synthesis meeting.

**Case three: pTA as propaganda in Finding Futures,** involves material analysis



and qualitative coding of photographs taken in Lisbon, Portugal, by a group of technology tourists who are attendees of the ‘Science in a Digital Society’ conference. This case centers on the question “what reflexive interventions allow publics to define the systems and technologies of greatest concern?” In this case, the participants are the inanimate photos rather than human subjects. They are the photos taken by a savvy group of self-selected STS scholars and policy professionals who elected to join tour organizers for a walk around Lisbon on the first evening of the ‘Science in a Digital Society’ conference. In this instance, I conducted a text and image analysis of images in a group Flickr library for the Lisbon event and their accompanying captions. I applied codes that relate to a typology of imageability developed by urban planner Kevin Lynch. I provide a detailed discussion of this coding structure and my method for working with the material visuals in section three of this chapter. I examine patterns of individual and collective sense making in this media analysis of the text captions and in the associations of captions with particular images. Through this coding scheme, I explore the role of the photographic medium in citizen-set agendas in pTA. I ask whether photography can aid a bottom up agenda setting process to establish future scenarios.

**CASE 1: pTA AS EVENT – SOMETHING “WICKED” THIS WAY COMES**

With a wild flutter of breath, they raised their eyes from the earth they had been treading. And the carnival was there.

“Hey...”

For the tents were lemon like the sun, brass like wheat fields a few weeks ago. Flags and banners bright as blue-birds snapped above lion-colored canvas. From booths painted cotton candy colors, fine Saturday smells of bacon and eggs, hot dogs and pancakes swam the wind. Everywhere ran boys. Everywhere sleepy fathers followed.

“It’s just a plain old carnival.” Said Will.

“Like heck,” said Jim. “We weren’t blind last night. Come on!”

-Ray Bradbury’s *Something Wicked This Way Comes* (1999, 60)



Figure 1: Graphics for the Flags that Designate Topic Areas at the Endless Table

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A few days ago, this communication appeared in the email in-box of the person whose remarks follow just below...

We are very excited that you'll be lending your perspective to conversations at the Endless Table for our upcoming *Let's Talk About Food* festival! Over the coming days, there will be even more information posted as we finalize all of the plans! This document shares logistics, content details, and addresses a number of questions you may have. We're *so* glad that you're part of this!

It will likely be crowded, so please plan to arrive 15-30 minutes ahead of your start time if possible. When you arrive at the festival area, you'll check in briefly at the Festival Operations Tent, which will be located on Cambridge Parkway near the Festival entrance.

You can see the operations tent marked in the map below:

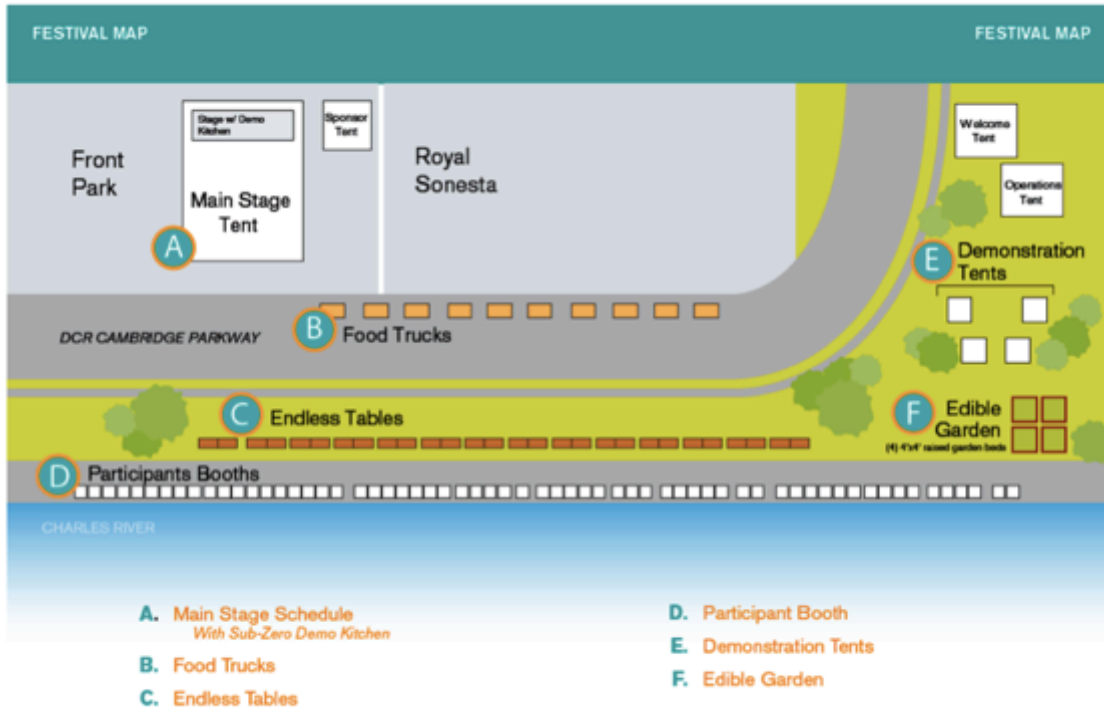


Figure 2: Map of the Let's Talk About Food Festival

When you arrive at the operations tent, a festival staff member or volunteer will check you in and give you a packet which will include a program booklet and map of the festival grounds. You will then proceed to the Endless Table content

area where you will be participating, and check in with the Area Host. They will help you get situated.

As one of our **Expert Conversants**, your role will be to roam around the subject areas, and participate in the discussions. The idea is that all of the expert conversants have diverse perspectives to contribute to the conversations. You will be identified by a special badge that identifies you as an endless table conversant. You do not need to prepare any special materials or remarks as an endless table conversant. You do not need to stay at a single table throughout your time, nor do you need to feel responsible for moderating or steering the conversations. Trained facilitators at each table will be on hand to keep track of time, handle transitions, and ensure that all participants have the opportunity to contribute to the discussion.

Comfortable dress is encouraged, you may also want to bring a hat and sunscreen. We will provide special nametags that indicate which topics you'll be discussing.

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The person who received the instructions printed above as an email gave this account:

I thought because of the weather and I thought the lack of publicity about it, for example it was not in the *Boston Globe* that morning, Saturday morning, in the G section it usually tells you what's going to be going on that day. I was very surprised that there was no mention of it. So I thought there was going to be a very poor turnout, but I got there and I was pleasantly surprised. I was amazed, actually, at how many people went to it. Nobody where I come from in the suburbs, I'm in Arlington, had heard of it or knew anything about it. None of the professional people I know had a clue about it.

I came in at the opposite end to where I had to register, so it was a bit of a trek to go all the way over to the tent at the other end, but it gave me a chance to see the layout. And I thought the demonstration tent -- I would have liked to have gone back to that. I never got to it because of my timing, but it seemed really interesting and it had a good crowd. And I think the conversant tables were a very good idea, but somehow I don't think the public really understood what was going on.

A second person who gives the next account received the following slightly different instructions:

Your **role as a facilitator** will be to keep track of time, handle transitions, and ensure that all participants have the opportunity to contribute to the discussion. Content will come from the discussion materials and our participating expert conversants, so you do not need any particular familiarity with the topic.

*In general, please avoid injecting your own opinions into the conversations.*

**Your role is to be an impartial facilitator for the conversations that will emerge.**

Conversations will take place in repeating **45-minute blocks**, with rolling seating overseen by the Area Hosts. These discussions will be repeated throughout the day. This will allow participants to take part in as all, some, or just one of the topic conversations at various areas within the Endless Table.

**The Appetizer (5 minutes):**

- Once your participants are seated by the Area Host and you're ready to begin, you should welcome everyone to the table, and introduce yourself as the conversation facilitator.
- Next, give everyone a brief opportunity to introduce themselves in one sentence.
- Finally, go over the Ground Rules for Group Discussion:

All Ideas Are OK,

No Interruptions,

Be Respectful of Others' Opinions, and

Give Everyone A Chance to Speak.

**The Main Course - (30 minutes):**

After the introductions and ground rules, it's time to begin the conversation!

The discussion will be inspired by facts and background information that are

delivered via a laminated **conversation placemat**. An example of the placemat for the Food Access Area is given below.

**Dessert (10 minutes):**

In this section, participants will attempt to develop an overarching recommendation in their own voices about the general topic, in light of their previous conversations.

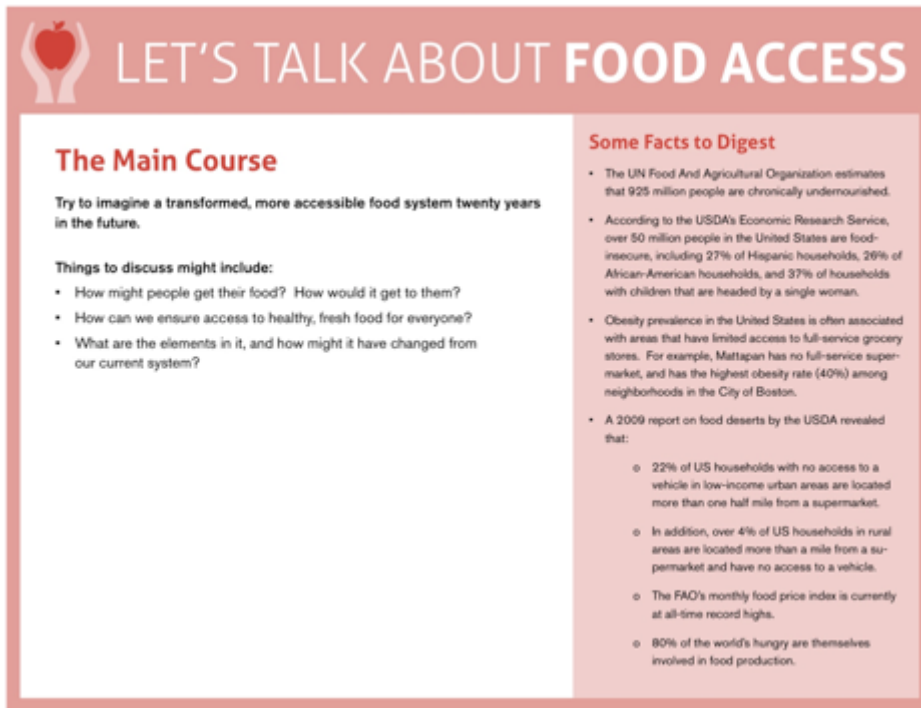


Figure 3: A Placemat at the Endless Table

The second person, who received the instructions printed above, has this reflection:

Okay. It was wet. I was walking in with other people and we walked up and said “Where do we go?” and they told us and we got our t-shirts.... I don’t remember if we had to do any paperwork. But then they sort of pointed us in the direction where we needed to go and we walked over... So it looked like people were sort of getting set up, and I assumed that... people were going to show up. And I hadn’t really thought much about how they were going to get there, but I guess I assumed that they would have signed up ahead of time to a slot, and apparently... And [I] found out as the day went on that no, that was not the case, that it was much more low-key than that and that people were going to sort of show up.... what I ended up doing was when people weren’t sitting down [I asked an

organizer] “So, how were you intending on people getting here, and... if you’re giving me money to do this, I want to make sure that I’m, and even if you aren’t giving me money to do this, I want to make sure that I am giving people a good product, so what is it that you are looking for, and is there something I am missing that I need to do?”

I sat down at the table with... a family that was sitting there eating and... what ended up working really well was we started talking and if people would walk by and look... I tried to make eye contact with every person I could and smile at them and say “Would you like to sit down and talk with us about seafood?”... They would sit down and eat their cupcake or whatever. The informal approach seemed to be really good at that table.

A third person is walking towards the Charles River in Cambridge Massachusetts on a Saturday morning and unexpectedly spots tents and a long table being set up. She has not received email describing this event, nor has she read about it in the newspaper. She describes the encounter this way:

As I approach the park along the river, it’s kind of puddly and muddy but it’s not raining and people are still setting up tents and this kind of thing. There’s a large tent at the end where cooking demonstrations are happening. Vendors, a lot of community businesses that are either doing food, selling food, a focus on things like Stonyfield Farms Yogurt and other local businesses. People are showing up kind of sparsely.

Running through the entire park is a long line of folding tables set up end to end and around that there are quite a few people wearing turquoise shirts. It seems like a few people are hanging around and talking a little bit.

There’s a jogger going through the park. People talking and walking together in groups of two or three. Seem to be a lot of young couples, which is to be expected here in Cambridge. Younger meaning, like, thirties. Right now there’s a wedding party of bridesmaids walking in brown dresses across the street into the park.

It was this day on the 25<sup>th</sup> of June in Cambridge, Massachusetts, that a public was constructed around an unusual event: a summer festival along the Charles River called

*Let's Talk About Food*. It was out of the ordinary, but no accident; the construction of this event and its resulting public began months before as staff at a Science Museum began planning and inviting people who would be there that morning to offer samples of yogurt. People hook up small demonstration grills to portable generators. The people who would come to the festival to enjoy the afternoon learned about it a few weeks before when an email blast went out to the membership of Museum of Science Boston directing recipients' attention to a website where there was more information. Ads were placed in certain newspapers. This is to say that an event like this one, and any event of pTA, takes some doing to let people know it is happening, and to get people to show up.

Museum employees have made this Endless Table event happen. They made sure that local businesses host booths where food is being cooked; they have arranged for trained facilitators, who mediate conversations for a living, to be there and that busy scientists and other professionals are there waiting for the opportunity to have a casual conversations about the politics of food. Founded in Boston, Massachusetts, USA in 2010, the *Let's Talk About Food* is a national, educational and event-driven partnership organization aimed at increasing the level of public literacy about all aspects of the international food system. From sustainability to food access, cooking to obesity, and food safety to food justice, *Let's Talk About Food* invites people across a spectrum of interests to join in participatory, engaging and meaningful conversations that can shape the place food holds in our communities, our world, and our hearts. The program's goal is



to create a community of “Food Thinkers” – a new kind of Food Think Tank that brings experts and the community together to explore food and food issues in our world.<sup>11</sup>

The Endless Table consists of rotating conversations at communal outdoor tables. Conversations had along the table that snaked alongside the Charles River explored areas such as health and nutrition, seafood, farming, and food safety. Each table accommodated ten to twelve community participants, one or two expert invitees, and was staffed by a trained conversation facilitator. Each facilitator invited small groups of citizens to make either individual or group recommendations pertaining to the topic after ~30 minute discussions.



Figure 4: The Endless Table in Action

Endless Table organizers instructed their experts on how to inhabit space at the table, how to behave, and what to say. This orchestration, common for the direction of a

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<sup>11</sup> Program description from (“Let’s Talk About Food Program Website” 2013).

play or a musical performance, is rare in the design of conventional pTA. In this informal setting, material presence and affect matter. Festival organizers set up the conditions for interaction as preparation. They structure the arrangement of tables and people at the festival. However, as the day progressed, unplanned and casual encounters multiplied the variation of how participants perceived physicality, knowledge, and the roles of the invited experts and facilitators staffing each theme.

This case teases apart the components and supports for pTA events untethered from existing formal TA event design like those introduced earlier in the chapter. To deepen my exploration into the assertion that opens this chapter, that pTA as event can be seen as an expression of the aesthetic of the *bildungsroman*, I construct an alternative way to conceptualize the individual pTA event. I introduced three first hand accounts of this convergence of a public at the Endless Table. These accounts are drawn from participant observation of festival activities and attendees, and eight semi-structured interviews with expert invitees, and conversation facilitators.

Pressures to increase the frequency and relevance of TA and pTA exercises has led to an idealization of what the pTA event should look like and what kinds of responses these should elicit in publics. Scholars of public engagement theorize that policy relevant deliberation is an ideal. However, in practice, pTA rarely delivers on this aspiration even when organizers pay careful attention to structural concerns that would contribute to the success of a given engagement (Rip, Misa, and Schot 1995; Worthington et al. 2012). If we are to figure out how to design deliberative events to draw out the natural capacities of crowds that are otherwise muted by processes that confirm and further perpetuate the

megamachine, including those processes meant to allow for public empowerment like pTA, we must reconceptualize the spaces, places, actors, and interactions that constitute the pTA event. In order to experiment further with pTA as a form, we must open up a conversation about pTA as a deliberative space.

I compare these stories of encountering the *Let's Talk About Food Festival* with an excerpt from a classic fantasy horror novel, Ray Bradbury's *Something Wicked This Way Comes*. The novel is an example of the popularized form of *bildungsroman*. In this instance a young-adult coming of age novel, wherein 13-year-old best friends, Jim Nightshade and William Halloway, encounter a traveling carnival that comes to their otherwise sleepy Midwestern town. The carnival's leader is the mysterious "Mr. Dark" who appears to have the power to grant the towns people their secret desires. The carnival's main temptation is its ability to change its visitors' ages easily against natural causes through magical rides and attractions such as a merry go round and a hall of mirrors. The boys must negotiate between the forces of good and evil in the carnival's strange context and use their personal insights to protect their neighbors and loved ones from the same perils. It is through these personal insights and compassionate acts to alert the town's citizens of the danger that the story plays out the social transformation of the *bildungsroman* form.

Dark's Pandemonium carnival in Bradbury's novel and the *Let's Talk About Food Festival* and its Endless Table of unusual conversations are ephemeral events that, for a short time, inhabit a familiar space but define the terms of engagement in that space in unfamiliar ways. In the quotation from Bradbury's novel that begins this section, the boys

have a mysterious encounter as the carnival enters town in darkness. The next morning the boys visit the carnival in daylight and enter what appears to be a normal carnival with all the customary rides and attractions, however the boys remain skeptical and believe that something else is going on, rendering the carnival sinister. A similar dichotomy exists with the *Let's Talk About Food* festival. The Endless Table pTA event, which has its particular arrangement of roles and props that invite people to enter into open ended conversations about the ethical legal and social dimensions of food politics is embedded in what otherwise looks like an ordinary summer festival that features local products and food demonstrations. Upon entering the festival space, visitors were unaware that they might be drawn into a conversation about the science and technology of our food system.

Three elements in Bradbury's story draw our attention to unique components of the *Let's Talk About Food* public festival as a real life analog to the fictional carnival. These three elements guide us to reinterpret pTA as a deliberative event in terms of the formation of collective capacities. These elements are 1) how the patrons of Bradbury's fantasy carnival illustrate how publics are constructed and the roles and the physicality of those roles layered onto the event; 2) the festival along the river, like Bradbury's carnival alike, as real places that embody an "enacted utopia," or what Foucault (1986) has called a heterotopia where aspirations can be realized by unusual means, and 3) the dual meaning of *wicked* both in Bradbury's tale and in the context of complex problems associated with the governance of food systems revealed in the content prepared for the *Endless Table* as pTA. Together these elements recommend parameters that PTA

experiments must satisfy in order to reconnect with both traditional and novel concerns about public engagement more broadly.

### **Constructing a public**

Among the many roles that happen organically over the course of a day in a public space, museum staff planned this pTA event and the dialog at the Endless Table around the interaction of three distinct roles: those of expert, facilitator, and the public. While these simplified roles encourage ownership and exploration in the context of a pTA event, they also constrain the behaviors of these actors. Importantly, in the context of this festival, assigned roles in this constructed public played out both as a function of knowledge exchange, but also in direct relation to the physicality of direct experience and encounters among festival goers. The designation of these roles as embodied in material and experiential relationships yielded unexpected associations between and among the three types of actors. The next section examines the festival as place.

Though there are endless permutations, no doubt, that could describe the interpretive frame that an individual might have when encountering this event, the three outlined here are by design in the context of this pTA. Each person comes to this same park by the Charles River to find an event gearing up there despite the puddled mud. Participants who received clear instructions in advance via email about how to arrive give the first two accounts. Organizers alert them about how to pick up colored t-shirts at an organizers table, what to wear and how to behave. The third participant received no instructions. Her role is to enjoy the festival. Perhaps she is an unsuspecting park visitor,

or an avid festival or museumgoer who saw some publicity about the event. Perhaps she is a democratic citizen interested in discussing the politics of the United States food system. This person takes take a stroll after a heavy rain on a summer morning and happens upon an outcropping of tents, food trucks and a long table that winds through the park, flanked along its way with colorful flag banners that say “let’s talk about seafood, farming, nutrition...” Just like the young boys in Bradbury’s novel who marvel at the tents, the whipping of flags in the wind, and the commotion they come upon suddenly, this passer-by finds that a carnival went up by the river overnight. By coming closer and sitting down at one of the tables, she enters the crowd, and becomes part of this pTA public.

Classic texts on boundary work usually refer to the borders between different knowledge orders, institutional, class or professional collectives (Guston 2000). But the Endless Table event also shows that assigned roles, and the body itself, are significant boundaries. One expert shared:

The thing is, logistically, [a facilitator] was sitting right opposite me. That meant no one could sit opposite me. So I think they probably need to sit less but move more. Get people who were standing in line for the trucks to come over and explain to them what this whole thing is about. What...This is their opportunity to talk to... **Because I don’t think people realized the difference between us.** And if a facilitator is sitting right opposite an expert, no one can get close.... it is people’s inclination not to sit beside or opposite other strangers. (emphasis added)

The long table’s structure and the scientist and facilitator discussants who wear colored t-shirts provide the physical structure for the encounters with the public and emphasize the delineation between those who are meant to be experts. One healthcare provider put it this way:

It's always an issue when you're a nutritionist sitting beside anybody, because they will usually look at their bodies and they will start feeling shameful about their weight, or they will say statements that indicate that they are not taking care of themselves, and so there's always that issue. It's almost like wearing a white lab coat. It's just the effect of being next door... its like sitting next to a dentist but having terrible teeth.

Overtly physical differences in the designation of roles in the Endless Table also extended to instructions about the types of information that the invited members could interject into discussion. Facilitators were asked to reserve personal opinions and anecdotes derived from their personal experience explicitly in the instructions that were provided:

We were told in the write-up that I received "We don't actually want you to have an opinion as facilitators. In fact, we would rather you didn't. We want you to get the conversation going, and draw people in..." So I had the impression from that that the experts were going to be the ones having opinions and letting people bounce off their opinions, and my responsibility was to support the expert. And what I found was there wasn't always an expert there, number one. And number two, sometimes it was actually useful for me to spout an opinion whether or not it had any basis in fact. I said "This is my opinion. This is not...I'm not an expert in this." Because then it got people talking and thinking about things and bouncing off what I said and that kind of stuff.

The Endless Table participants, consisting of scientists and professionals, facilitators, and visitors to the park and the *Let's Talk About Food* festival that day differ from one another based on the level of instructions they received from the museum organizers. Experts and facilitators interpret their instructions, an important design element, and enact them fluidly as they participate in the festival.

The vignettes that launch this section demonstrate the very different experiences our three sets of actors had when they encountered the festival that day. Organizers accounted for three distinct roles in the design of the event: specific roles for facilitators,

scientists, and the public each looking after a particular experience in the carnival. While these roles encourage ownership and exploration in the context of the event. They also constrain the behaviors of these actors.

### **pTA as heterotopia**

Bradbury's carnival and the food festival are both instantiations of enacted utopias, or what Foucault has called a heterotopia. Heterotopias can hold for a particular point in time contradictory impulses and activities (Foucault and Miskowiec 1986; Shane 2005). Heterotopias are spaces "that have the curious property of being in relation with all the other sites, but in such a way to suspect, neutralize, or invert the set of relationships that they happen to designate, mirror, or reflect" (Foucault and Miskowiec 1986). For Foucault, creating utopic conditions in an actual physical space represents a strength, but for pTA organizers, designing and making spaces for public deliberation that can connect to decision making has been a conundrum.

Parkinson (2012, 16) suggests that there are four components to a deliberative space: it is openly accessible; and/or uses common resources; and/or has common effects, and/or is used for the performance of public roles. Parkinson observes the lack of deliberative spaces in civic life and also asks whether particular spaces, while deliberative, uphold democratic ideals. His concern also articulates a concern among pTA practitioners. The perceived scarcity of democratic public spaces as a concern exerts pressure on the design of pTA. Practitioners, in response, produce particular kinds of designs that attempt to counter the condition of scarcity. These designs lead to the



creation of heterotopic spaces whose architects strive to actualize the ideal conditions for dialog that are perceived as being rare in civil society.

In a follow up study of participant perceptions of a pTA called the National Citizens Technology Forum, a public dialog on human enhancement coordinated at multiple sites under the NSF funded Center for Nanotechnology in Society at Arizona State University, Cobb and Gano have noted that “ordinary Americans [may] aspire to try new models and fora, and that they value debate that encompasses diverse perspectives even when the policy outcomes are uncertain” (2012, 107).<sup>12</sup> In the US, political affiliations are polarized and media representations of value issues have become more extreme. pTA and public engagement opportunities that allow a diverse public to explore or to develop a critical stance on particular issues outside the usual political frameworks appear novel to participants surveyed and may appeal.

Further, the conversations were unique because by design the issues were framed in a way that asked people to not only draw upon their personal interests, but also to articulate their sense of collective values and of the political. One facilitator remarked:

Well, this is all tying into the food politics of America, so I think it was a deliberate topic that they chose from that angle.... [the framing begged the question] what should we do as a nation? What kind of public health or legal steps can be taken? It wasn't on an individual basis, like a practitioner like me working with childhood obesity. [these were] very political questions, really. Are we going to tax people for drinking soda, for one thing. I think that's extremely political. It's not a nutritional question. It's a political one. To me, the issues around childhood obesity are much more than just the areas that they have identified. It's a very complicated issue, and it's so easy to point fingers at just the issues that they came up with, especially sugar sweetened beverages. There's no mention of parenting styles, what's happening to society in America, or food insecurity,

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<sup>12</sup> For a full description of NCTF refer to (Hamlett, Cobb, and Guston 2008).

which is a big cause of childhood obesity. There are a lot of issues [the science and social context] that just aren't raised.

This expert noticed that the dialog event was framed to encourage people to deal with particular scientific and technical topics from the perspective of collective and what he thought of as political values.

Interviewees acknowledge a quality that was present in the conversation on the day of the festival that was a function of the deliberative design. In their instructions to the expert and facilitator participants, museum staff sought to elicit critical appraisals by public participants of each discussion topic. These conversations were meant to build over approximately thirty minutes and then lead to each ad-hoc group making informal recommendations about how to handle the particular topic.

In one example recommendation to improve nutrition from the Endless Table, a stay at home mom sits down to talk about food safety. She remarks that as one gets older one must be more careful about food preparation. She recalls taking home economics in her secondary school; this recollection leads her to remark that she is interested in exploring how new forms of consumer regulation might help people make better food choices. She cites the value of an intermediary service that helps people understand food safety like the tools that the company Weight Watchers provides to simplify calorie counting to a points system. With the help of the facilitator, the group this mother is a part of cooks up the idea of creating a checklist for restaurant kitchens that would be not a government regulation, but instead a type of certification that could be used to allow the

restaurant to show that it was being more conscientious about nutrition and calorie counts. Oversight of the checklist could be crowd sourced using a mechanism like “Angie’s List,” an online service with a subscriber and reviewer base of more than two million households listing local service providers, like roofers, plumbers, handymen, mechanics, doctors and dentists. In just this way, participants in conversation at the Endless Table operationalize problems and are enrolled in the design of possible solutions that themselves can offer future benefits, but that also could pose new risks. By design, facilitators move participant conversations toward closure in the form of a recommendation; the Endless Table not only implicates the public in the risk paradigm, but it also sets the expectation that contributors will engage in problem solving and articulate future directions, rendering the public complicit in and responsible for their civic engagement.

***Something Wicked This Way Comes: pTA and Wicked Problems***

By the pricking of my thumbs, something wicked this way comes.

Open, locks,  
Whoever knocks!

-- *Macbeth* (Shakespeare 1893, 48)

For the two fourteen year-old boys, Jim Nightshade and William Halloway, who are swept up in the carnival in Bradbury’s novel, the feeling of wickedness and foreboding represents the unknown future of becoming men, facing frailty and the diminishment of potential through experience, desire, and temptation. On the other hand, the boys also learn that the power they assign to people, material conditions, and ideas in their own minds is directly proportional to the hold these forces have on them, and also to

their degree of fear they harbor about the unknown. The attraction and sinister nature of Mr. Dark and his Pandemonium carnival lies in the degree to which the unusual conditions generated in the carnival as place provide wish fulfillment. The boys learn that replacing their fear with positive emotions banishes their anxiety and liberates fellow townspeople who have fallen prey to promises of eternal youth and escape from death to banish the evil influences associated with the carnival.

Just as with the Bradbury's carnival, participants in the Endless Table experience a similar tension that for the moment we will call "wicked." Festival goers must brush against strangers and come into close physical contact as one does in a crowd;<sup>13</sup> there is risk involved in congregating in a public space. In addition, visitors to the park who encounter the Endless Table also confront the risks inherent in public engagement: unfamiliar (scientific and technical) information, social and political framing of topics, and competing visions of the future. In this sense, the potential stimulus that the public encounters at the Endless Table is a trifecta of unfamiliar physicality, knowledge, and forecasts that confirm or challenge established worldviews. The same qualities that set the stage for an engaging informal science learning experience can represent challenging moments for individuals across many dimensions. This is an example of the risks involved in creating and maintaining deliberative spaces and adjudicating these in such a way that diverse voices can contribute and evolve the discourse.

"Wicked" in the broader context of science and technology policy has yet another shade of meaning. As I have reviewed in Chapter Two, Beck (1992) asserts that society is

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<sup>13</sup> Recall from chapter two that Canetti defines being touched as a central fear of the individual with respect to crowds.

in a final stage of reflexive modernity wherein systemic sociotechnical issues with global reach make it impossible to confine risk or unintended consequences in time or space. Drawn from literature on complexity and risk governance, work on ‘post-normal science’ provides a heuristic for thinking about ways that complex ‘wicked’ problems can be addressed, what knowledge can be marshaled, and what interactions are necessary (Farrell 2011; Funtowicz and Ravetz 1992).

## **Discussion**

Three story elements derived from *Something Wicked This Way Comes* have drawn our attention to unique components of this informal science education event. This empirical segment teases apart the components and supports for pTA events unmoored from existing formal TA design like those introduced at the beginning of this chapter. This experiment in public deliberation in an informal science education (ISE) setting is an example of science communication as emergence in what Horst and Michael (2011) call public engagement as “event,” or “the coming together of different elements through which novel relations and identities occur” (2011, 284). Science communication as “emergence” differs from other conceptions of the form, for example as “diffusion,” or as “deliberation” which invokes a critical attitude aimed at evaluating scientific and technical information.

Science communication as emergence mixes and intertwines the diffusion and deliberation and converges in an event to the extent that when a physical convergence of people and knowledge occurs, this public not only convenes in a place, but “becomes” together (2011, 286). Horst and Michael’s concept of science communication as

emergence supports my assertion that to evolve pTA practice to better incorporate talent that is hidden in currently marginalized collective capacities, one must take *bildung*, or individual and collective formation, as the goal of public dialog. The Endless Table case combines elements of formal deliberation that invite the public to consider impacts of science and technology in society with informal science communication methodologies cultivated in science museums that scaffold free-choice learning experiences.

To summarize, a physical place; the mixing of physical bodies, knowledge and expectations among experts, participants and the public; and the focus on future solutions make the Endless Table a kind of enacted *bildungsroman*. This heterotopic festival, meaning enacted ideal dialog event, by the Charles River convenes people and organizers to create the conditions whereby the inner self must address and reconcile its position relative to the broader social and cultural world. The model of science communication as emergence that I invoke from the Horst and Michael paper makes the point that publics have many behaviors and reactions in the context of the science communication event that a diffusion or dialog model don't account for. When a member of the public misbehaves (or acts “idiotically”) standard evaluations of science communication discount or eradicate those reactions (Horst and Michael 2011). Organizers of the endless table attempted to strike a balance between the structured model of engaging scientists and engineers as expert science communicators teaching the public about science. However, museum staff also made room for the chaotic environment of the festival and the behavior of “idiot” as well by trying out a new open-ended form of dialog.

To conclude, I return to the notion of *bildung*, or self-formation, in this case of publics, as a central precept of the pTA event. Taken together the notion of development as central to the pTA event places the focus on collective capacity building and allows the STS scholar to move analysis forward beyond the blow by blow of interpersonal power dynamics to take into account the concepts of actor networks and the higher order structures that constitute the strengths and weaknesses of crowds (as in the case of Canetti's crowds). The literature on pTA has tended to focus on one-off events rather than on systemic interactions that make up deliberative democracy (Dryzek 2010). Public engagement programming in ISEs, though more common internationally is still an evolving model. In addition to the difficulties of fundraising, recruiting and staffing pTA events like the Endless Table, the relative rarity of PES activities in science museums at this time also places constraints on how well less-formalized pTA activities can catch on at other institutions with a more diffuse missions and scarce resources. The question for experimental pTA going forward is how to design pTA so that it works with, enhances, and stimulates broader deliberative systems to do their job better. The Endless Table had some successes in this regard, but also, through the limited nature of pTA as a unique event, and through the assignment of rigid roles, circumscribed the behavior of some key actors.

## **CASE 2: pTA AS WAYFINDING – CNS-ASU FUTUREScape CITY TOURS**

### **PILOT**

Case two centers on the question “how can we connect experiential methods to deliberative processes in pTA?” This fieldwork consists of participant observation of participants, expert invitees, and event organizers involved in a pilot activity undertaken by research leads at the Center for Nanotechnology in Society at Arizona State University (CNS-ASU) under the auspices of the Anticipation and Deliberation strand of the Center’s work. CNS-ASU is a Nanoscale Science and Engineering Center (NSEC) funded by the National Science Foundation in October 2005 that has received two five-year center awards at for \$6.2 and \$6.5 million respectively. With major partners at Georgia Tech and the University of Wisconsin-Madison, CNS-ASU is the largest center for the social study of emerging technologies in the world.<sup>14</sup> The center aims to develop tools and research for envisioning ways to anticipate the transforming power of emerging technologies and to govern them appropriately. Research strands emphasize foresight and anticipation; integration of societal perspective in research laboratories; and broader public engagement. Research leads in the “Anticipation and Deliberation” area conduct scenario workshops that assist stakeholders and citizens in envisioning alternative futures and in participant action research conduct public engagement exercises including the National Citizens Technology Forum (NCTF) described elsewhere in this manuscript. NCTF used a consensus conference model in multiple cities to solicit citizen recommendations about the future of human enhancement technologies including

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<sup>14</sup> See (“The Center for Nanotechnology in Society at Arizona State University Overview” 2014).



nanotechnologies (Powell, Delborne, and Colin 2011; Hamlett, Cobb, and Guston 2013; Wickson, Cobb, and Hamlett 2011; Philbrick and Barandiaran 2009; Hamlett 2007).

Given center affiliate experience with public dialog formats both in theory and in practice, interest in experimentation with new formats for citizen dialog, or pTA, is an aim.

In November of 2012, CNS-ASU hosted a pilot version at a single site of what in 2013 became an exercise of Futurescape City Tours in six different cities to bring together citizens and stakeholders to discuss the potential role of nanotechnology and other emerging technologies in the future of their city. Organizers of the Futurescape City Tours (FCT) pilot convened a panel of fifteen citizens to discuss the implications of future applications of nanotechnology for the city of Phoenix, Arizona. Project leads' stated aim of the project was to build up citizens' skills to engage with complex technological subjects and to develop and articulate their own views on the desirability and implications of nanotechnology. In doing so, CNS-ASU researchers created a space for deliberation about technology and society that enables small groups of participants to interrogate the directions such technologies are taking. The central activity that also represents the innovative format of this dialog was a guided walking tour of key locations in Phoenix that allowed participating citizens to explore locations in the built environment that could soon be enhanced by applications of this emerging technology in areas such as water management, energy conservation, resilient materials, and other issues.

The FCT model involves three meetings of the citizen panel and a closing public reception and exhibit. In the first meeting, the citizen panel gets acquainted and learns the project background. Through small group exploratory discussions, participants identify potential themes that guide the selection of locations and particular research and technologies that will inform the design of the walking tour. The aim with beginning with citizen-set agendas echoes a similar call for “organic engagement methods” which seek to understand the discourses and social practices that define existing publics (Gehrke 2014). The second meeting is a full-day walking tour. Based on the first meeting with the citizen panel, the tour included sites that related to the themes: solar, biofuels, transportation, and water. The tour group also met invited experts: scientists, engineers and other professionals, at each of the tour sites. These individuals supplied information about how emerging technologies might change aspects of the city related to each theme.

Participants took photos during the walking tour to capture images that represent their perspectives on the past, present, and future of technologies in the city. Organizers made tour guidebooks available that contained an overview of the tour themes, locations and invited guests. These books included pages for note taking. Tour participants used the notebooks to record reflections during the day and to inscribe their thoughts associated with particular photos. Organizers asked participants to select twenty photos total representing images of the past, present and future of Phoenix and to make brief captions for each. Participants then uploaded their photo selections and captions to Yahoo’s web-based photo sharing application, Flickr, using an instruction set provided by the project team. Organizers printed physical copies of the participant photos for use

in the third and final meeting of the project.

In this third meeting, organizers facilitated exercises and small group discussion with the goal of eliciting individual and collective group interpretations of the photo collection. Three main exercises on the past, present and future of Phoenix bounded conversations and directed the public statements each group made about their explorations and illustrations of each topic.

Next I propose a framework to contextualize this new model of citizen-directed material engagement with technologies in the city. I invoke the term ‘wayfinding,’ which in design and architecture refers the art and practice of spatial problem solving. I suggest that the participatory research method used by urban planner Kevin Lynch to understand how elements in the built environment contribute to how citizens perceive their cities, and that founded wayfinding as a design practice, is an analog to the experiential and material pTA methods in the FCT pilot. Lynch defines wayfinding as “a consistent use and organization of definite sensory cues from the external environment” (1960, 3). In the same way that wayfinding practices aim at making urban settings understandable and functional for city residents, experiential and material pTA methods in FCT have the potential to render hidden scientific and technological infrastructures and systems understandable and useful for urban publics.

### **Wayfinding and Imageability**

In his classic work of urban design, *Image of the City* (1960), Kevin Lynch asked citizens of Los Angeles, Boston, and Jersey City to draw maps of their city from memory.

The resulting drawings and interviews led Lynch to coin the term *imageability*. This term refers to a typology of urban features that Lynch established as he analyzed this data to ascertain which city forms are memorable, compelling, and useful to the people who live and work there. Lynch's five categories of imageability are:

- Paths – channels along which the observer customarily, occasionally or potential moves.
- Edges (barriers) - linear elements not used or considered as paths by the observer.
- Districts – medium-to-large sections of the city, conceived of as having two dimensional extent, which the observer mentally enters “inside of”
- Nodes (intersections) – the strategic spots in the city into which an observer can enter, and which are the extensive foci to and from which he is traveling.

Landmarks – another type of point-reference, but in this case the observer does not enter within them, they are external. They are usually a rather simply defined physical object: building, sign, store, or mountain. Their use involves the singling out of one element from a host of possibilities. (Lynch 1960, 47–48).

The method associates citizen perceptions with material characteristics in the city's form, providing data for urban planners, designers and architects to use in the design of features in the urban landscape.

Imageability now informs the professional design practice called *Wayfinding* that seeks to make everything from public places to virtual information spaces easier to understand and to navigate (Passini 1984). While the legacy of Lynch's original research

into public perceptions of city morphology improves the repertoire of urban planners, designers, and policymakers, there is not yet a similar method for making scientific and technical systems more visible and legible for the people who use them. The general public remains largely in the dark when it comes understanding or having a significant say in governing how existing and legacy infrastructure as well as new and emerging technologies will impact lives in the cities in our future. Often only when systems malfunction or fail do the impacts of past decisions about where to use technologies become clear. In the context of slow violence, however, it can be even more difficult to determine any particular systemic origin that perpetrates suffering.

This segment examines experimental pTA aimed at improving public disaffection with scientific and technical decision making in cities. I revisit Lynch's method and borrow his typology of urban imageability to bring a variety of public values about technologies in cities into sharper relief. As I identify social, political, ethical and cultural values expressed by participants in the FCT pilot exercise I map these value statements to select categories in Lynch's typology. I assert that these value statements signal the presence of collective capacities. These collective capacities could form the basis for new design and development criteria for technologies based on social, legal and ethical concerns. I use Lynch's typology of material elements in the city to differentiate between and among the qualities of these value statements and to link these statements directly to material and experiential aspects that participants encountered during the FCT tour.

In this exercise I translate Lynch's rubric as these relate to FCT discussions about the past, present and future of Phoenix: the definition of landmarks maps to the past,

paths and edges maps to values reported in the present exercise; districts and nodes map to the future. The experimental pTA method of the walking tour and participant photography in *Futurescape City Tours* forges a new kind of wayfinding. Methods that rely on materiality and experiential learning require that participants seek out and interpret often hidden technological systems in the landscape. These methods reveal something about the collective human capacities that craft, maintain, and imagine the future of these systems. Different than a typical consultative model for pTA, participants drew from their direct experience with experts and the walking tour to further explore the themes solar, biofuels, transportation, and water and to reflect on how technologies of past present and future might impact their everyday lives. In one example, a participant selects a photo to represent a near future state and remarks “[first I] start with the downer -- the guy who was cleaning the sidewalk - will this man's job exist in the future? [I think] we will leave some people behind.” While another holds up an image of a single solar panel and projects into the future without political obstacles “ if every flat rooftop was covered with solar panels we could generate all the city's power. Hopefully if we get somebody new in the legislature we could be the Saudi Arabia of the world -- let's say in 2030?” This technological wayfinding tells us not so much about the quality of our systems, but more about the nature of our systemic relationships and the imaginaries that inform our use of them in everyday life.

## *Methods*

I draw my observations from the analysis of notes made during participant observation, image and caption analysis, as well as video recordings of the participant reports associated with three deliberative activities conducted at the closing session of the pilot tour in December 2012. The three exercises and associated group discussions and participant statements were centered on an exploration of past, present and future in the city of Phoenix.

The past exercise involved selecting from among the collection of photos that had been tagged to represent “past” by the group. Participants could choose any three photos that they wanted to from a pile of photos that were strewn on a table. Organizers split the participant group was into three tables of approximately six people. At each table participants discussed and then selected three of the photos that they most felt represented the past persisting in Phoenix into the future. I associate this exercise with identification of landmarks in Lynch’s typology of imageability. For Lynch, landmarks are an external “point-reference... their use involves the singling out of one element from a host of possibilities...” Landmarks signify the identity of the city’s form and give one’s experience familiarity (1960, 48).

For the exercise dealing with the images tagged “past” in the Flickr collection, participants selected two printed photos from among a group of these images strewn along a long table. The prompting question for this selection was “what images represent the persistence of the past today, for better or for worse?” After making photo selections, citizens returned to their tables and a facilitated discussion about this question ensued.

Participants at each of the three tables were asked select three photos that best represent the groups' sentiment about features that persist in the city and displayed these photos on a flip chart. A spokesperson from each group transcribed a statement for each of the three images pointing to the reason for the selection and characterizing the associations that came up for the group. This person also reported out in a large group share about the decisions of the group.

The past exercise has two significant design elements that elicit value responses I associate with Lynch's "landmark." The first is that among all the group exercises that participants took part in over the course of the three meetings, this discussion about the past is the only one where participants in each small group came to consensus. The second determining feature has to do with the association of the past with the quality of persistence. The association is made more explicit with the instruction to write "Past Persisting" as the title for the shared image space at each table.



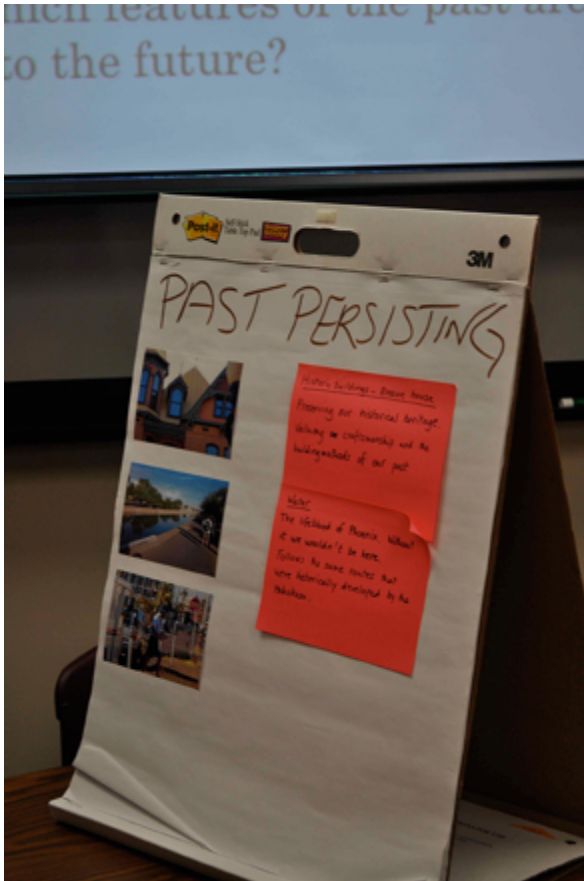


Figure 5: Past Selection of Photos

“The future is already here — it's just not very evenly distributed”: Just as in the quote attributed to science fiction author, William Gibson, remarking on the uneven distribution of material futures in the city landscape, artifacts from the past are also unevenly residual and sometimes vestigial in Phoenix’s landscape. Participants selected and promoted images taken of the corner of an old building that is juxtaposed with the corner of a new building, water infrastructure in the canals, the university’s presence in the form of signage on buildings downtown. Participants at two of the three tables select

the image of a mailman with a similar interpretation of the man in the cap with his back to the camera as a representation of the primacy of communication.

The twin design constraints, consensus among the tables on which three images to select and interpret publically, and the focus on the past persisting brought out two aspects of collective capacities of Phoenix city dwellers as represented by the FCT participant group. One is the use of analogies of the human body in the material forms of the city and the other is the assertion of essential human needs as the criteria for identifying what material forms and arrangements will persist in the city.

Two of the three groups identified water and the canal site as an important persistent element in the city's past. One presenter remarked that canals "are the arteries of civilization" with the idea that even though there is an accepted understanding that ultimately they are man made by the Hohokam Indians who first settled the land, that the canals' longevity in the landscape naturalizes them. The participant who presents his group's selections in discussion explains: "its not like we dug them up, they were already here." The canals cease to become a technology imposed on the landscape, but instead are part of the desert ecology.

The second aspect is the identification of common persistent elements based on the criteria that these forms provide or support essential resources for living. Water and shelter are specifically mentioned:

Water is so important no matter what society, if you are going to the beginning of time or even when there's talking [of going into] space [the question is always] "how do you provide water?"

Shelter, you know we need that more than a lot of other things in our environment. In most environments we can last several hours without shelter, and we can last several days without water, and several months without food.

Shelter, in the context of the harsh desert climate, is more crucial than even food and water to survival according to this participant. Several speakers identified transportation and communication or knowledge transfer also as essentials for survival.

One table selected an image of the Rosson house in Phoenix's Heritage Square. Unlike some of the other buildings in this popular square that shares the pedestrian walkway with the city's Museum of Science, the Rosson House stands in its original location. This 2,800 square foot Eastlake architectural style Victorian home was built in 1895 in early Phoenix during Arizona's late territorial times. The Rosson House was innovative both in terms of the building material used to create it – fired brick and wood instead of adobe – and for its then modern conveniences -- "the electric light," hot and cold running water, and indoor upstairs bathroom, and a telephone. The discussant emphasizes the building depicted in the image as a signifier of craftsmanship:

We wanted to show that it is not just the building, but also materials, the craftsmanship, the people, the heritage, and the values that ... you have as a society. If you don't have heritage and values, you might crumble and fall apart. But when you start valuing those like these buildings, you are valuing the people. You are valuing the craftsmanship, and that's when you raise above just surviving... in a city, you become a culture with feelings and interests and it makes it much more richer [sic].

Overwhelmingly in the past exercise participants selected "landmarks" in the city that map to value statements about basic human needs. In places where participants perceived the built environment as supplying basic needs, participants tended to naturalize those technological systems and in some cases see them as analogs to human anatomy (the

canals as “arteries”). Participants also categorized the capacities for transportation, communication and craftsmanship as human needs. It is fitting to class these essentialist value statements as “landmarks” under Lynch’s rubric, for his material landmarks are naturalized in the urban setting: “if identifiable from near and far, while moving rapidly or slowly, by night or day, [a landmark] then becomes a stable anchor for the perception of the complex and shifting urban world” (1960, 101). The FCT participants were asked to evaluate the technologies of the past in the urban environment, the criteria for evaluation in the FCT pilot pTA revealed value statements that can be interpreted as underlying assumptions about what social, political, legal and ethical infrastructure is necessary for maintaining continuity in urban life.

In the Present exercise, photos from the Flickr collection tagged “present” were taped at random to a plate glass window that separated one side of the meeting room from the outside courtyard. During this activity, participants got up from their tables to have a look at the photos fixed to the glass and selected two images that for them best represented characteristics of the present in Phoenix. Associations with the present state of the city could be positive or negative. Without removing the photographs, participants recorded their thoughts on sticky notes at their tables, selecting orange notes for positive and blue notes for negative. Having recorded their thoughts, participants placed their notes on the wall near the two photos that they chose. Then as a part of a dinner break, participants circulated in the room, looking at the images and took note of what others called out and commented upon from the collection privately. Notably, this exercise did

not involve a group discussion or the recitation public position statements. None of the participants attributed their names to the comment notes.



Figure 6: Present Photos

Images that received one or more comments can be divided into three categories: pictures that depict urban infrastructure and the built environment, those that show people or evidence of community projects, and those that depict various types of signage or graffiti.

Looking at the overall balance of positive versus negative views of the city's present among participants based on the color participants chose for the exercise, one half (fourteen) had positive and the other half negative attributions. One participant admired infrastructure, selecting a picture of adjacent building edges, almost touching, with an old brick structure next to a new building of new construction with a caption that read "this image best showcases Phoenix now! An interlocking puzzle of old and new." Another set of images celebrates public spaces and community: one depicts people gathered around an information booth at the downtown farmer's market labeled "celebrations of culture, unity, pride dependence on one another in order to thrive sense of community." A third group of photos depict various types of signage or graffiti. One telling image singles out a

silk-screened flier posted on a telephone poll that reads “film the police, no racial profiling,” with text in English and in Spanish, captioned “democratization of information helping bring authority to be accountable.” The six images that show community activities as important to “the present” received singularly positive comments.

Additional images in the other two categories make statements about present infrastructure and signage, public art or graffiti triggered both positive and negative associations. Images of abandoned lots surrounded by chain link fences, epitomizing the lack of infrastructure, attracted the comments “wasteland, unused ugly, ugly graffiti on sign” and “lack of investment disengagement of community.” Similarly, in this interesting category of images that show both sanctioned or unsanctioned public messages in the form of billboards or broadsheets, criticisms ranged from an image of a billboard along the canal system with the caption “billboards over art should not exist at all or at best their placement should be regulated a bit” to an elaborate mural showing the infamous and long time Sheriff of Maricopa County, Joseph M. "Joe" Arpaio, and Arizona Governor Jan Brewer as skeletons sharing a beer and a taco with the note “preserving power and privilege.” With a long tenure in the state, “America’s toughest sheriff,” Joe Arpaio, is known for his ultra conservative views on immigration and border issues as well as his extreme treatment of state prisoners. The female figure is Arizona’s governor Jan Brewer, a signatory to the 2010 *Support Our Law Enforcement and Safe Neighborhoods Act* SB1070, which makes it a state misdemeanor crime for immigrants to

travel within the state without carrying registration and applies stricter penalties to anyone sheltering illegal aliens.

In some sense, these three value areas associated with the present: infrastructure, law and policy represented in the images of signage and graffiti and community portrayed in pictures of the farmer's market and of children are in reaction to what Canetti calls "domesticated commands." These commands are mechanisms of control embedded social relationships, families, and states. The present exercise with its more private and individualized format and the focus on present conditions revealed three aspects of collective capacities of Phoenix city dwellers in interpreting their present conditions. These aspects link to Lynch's paths and edges. Both paths and edges relate to everyday movement and encounters in the city as well as those features that bound and limit motion.

The final session of the evening directed participant attention toward the future. Organizers affixed long white sheets of butcher paper to a wall and used color sharpies to mark out a timeline. Researchers inscribed years in increments from a near to far term horizon: 2015, 2020, 2030, 2040, 2050 horizontally. Vertically, program hosts indicated a range from desirable to undesirable. Participants selected three snapshots from a pile of loose print outs of the Flickr photo collection that had been tagged "future" during the tour. People wrote on sticky notes reasons why for each of the three images represented a possible or aspirational future state in Phoenix. Each person then stepped in front of the butcher paper timeline individually and contemplated when such a future might unfold and whether that future was desirable or undesirable. As each person placed the

photograph on the timeline and spectrum of desirability, she narrated her choices, reasons and rationale for placement publically to the group.



Figure 7: The Future Timeline

As in the “present” exercise, organizers wished to determine whether a particular idea has positive or negative connotations. Instead of forcing a binary choice by asking people to select a color that would indicate either positive or negative, participants could indicate degree or intensity by placing their examples along a scale. Different from the earlier exercise, the “future” canvas allowed participants to work within a range and to consider tradeoffs in the placement of their contributions. Individuals also registered their views relative to those of the other participants through the placement of the photos on the timeline.



Table 2: Temporal Aspect Correlated to Imageability Types and Value Statements

<b>Temporal aspect</b>	<b>Imageability Type</b>	<b>Value statements</b>
Past	Landmarks	Essential human needs for resources such as water, shelter and communication, transportation, craftsmanship are identified as persistent
Present	Paths, predominantly in the image & edges	Equally positive and negative, value statements are about infrastructure, legal and policy, and community. All statements are versions of resistance against domesticated commands.
Future	Districts and nodes	The group acknowledged their collective orientation toward hopeful futures.

Participants placed individual photos across the timeline from near-term to far term developments. In general comments trended toward desirable developments. For example one interviewee wanted local food production to become the norm:

So this is a picture of a garden and I have (reading from sticky note) “green and sustainable growth as an aesthetic to include food production and food production becomes local again.” I am revealing my rose colored glasses. I think it is going to take awhile, actually... Yeah I mean it happens small scale... [now, but] I am after the large scale.

A common reason several participants chose to place a photo and the future state it depicts, further down on the timeline toward 2050 was due to a perceived barrier in the lack of political change. One participant remarked that “a generation” may need to pass in order to make renewable energy initiative for solar a reality in Phoenix. Likewise

another speaker reports that her children will need to have grown and had their own children before a general acceptance of diversity among Phoenix residents will come to pass. I map this example of the future political shift that makes change possible to what Lynch calls a “node.” Nodes are parts of districts and “are the conceptual anchor points in our cities” (1960, 102). When well positioned inside paths that residents cross everyday, nodes are unforgettable. Famous nodes are Times Square, and the Duomo and the Palazzo Vecchio in Florence, Italy. Nodes are places where the city dweller can intuit the “presence” of the city’s form around him (1960, 103). The analogy here lies in the definitive way that FCT participants describe decisive value positions that would curtail or enable future material states such as the scaling up of new transportation and energy production methods. None of the participants spoke about these junctures in terms of a lack of technical capability; instead culture and politics were the deciding factor. These associations of public values to future innovations are consistent with Mumford’s view of the megamachine wherein collective capacities drive the speed and nature of future production and technological development relative to material conditions.

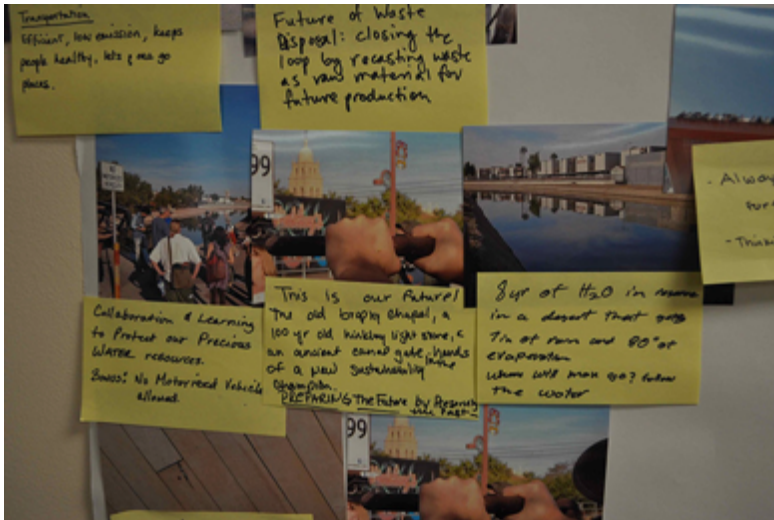


Figure 8: Detail of the Future Timeline and Captions

Finally, the FCT group took stock of the completed timeline and reflected on the placement and nature of the remarks. The group acknowledged their collective orientation toward hopeful futures. Individuals admitted to selecting photos from their total collection from the tour that represented more becoming spaces and places. Ugly or politically sensitive spaces were omitted along some dimensions. For example, no participants took or selected photos of homeless individuals who could be found in several places on the tour.

This transposition of elements from the concrete experience of moving around in an urban space to the collective ways of understanding and of interacting during an pTA event through the association of Lynch’s rubric of imageability and participant value statements is my attempt to map the essence of collective capacity building that is possible in a pTA that involves experiential activities. As I conclude this segment, I want to review the assumptions that Lynch makes about the value of city in which citizen

wayfinding is well –prioritized and ask if designers and practitioners of pTA have the same aspirations for technological wayfinding.

Lynch proposes that:

“A highly imageable (apparent, legible, or visible) city in this peculiar sense would seem well formed, distinct, remarkable; it would invite the eye and the ear to greater attention and participation. The sensuous grasp upon such surroundings would not merely be simplified, but also extended and deepened. Such a city would be one that could be apprehended over time as a pattern of high continuity with many distinctive parts clearly inter- connected. The perceptive and familiar observer could absorb new sensuous impacts without disruption of his basic image, and each new impact would touch upon many previous elements. He would be well oriented, and he could move easily” (1960, 9–10).

A city well equipped for wayfinding has material qualities that make it transparent and understandable to citizens. Designers and practitioners of pTA believe that these same characteristics are important for technological wayfinding. Transparency forms the basis for broader public engagement in science and technology policy. In short, transparency is a democratizing force and thus a primary organizing principle for pTA design.

This case has highlighted the convergence of three important strands: STS interpretations of the influence of technological systems, everyday experiences of technologies on the street, and how these intersect with time. I have reinterpreted Lynch’s categories of urban imageability to make sense of public perceptions of technological systems in cities. Rather than using the qualities of imageability to identify ways to improve the design of material urban landscapes, I have used the material to identify collective capacities that surface in the participant panel as a function of an experiential walking tour. Lynch’s method of wayfinding, rendering the built environment both

understandable and navigable, is an analogous approach to addressing systemic and sometimes hidden scientific and technological infrastructures through the experiential and material pTA methods in the FCT pilot. Images from this pilot project reveal that experiential and material pTA methods in FCT have the potential to render hidden scientific and technological infrastructures more transparent not because these methods focus on education about these seldom-popularized city infrastructures, but because the process allows people space to articulate individually held values through the use of material and experiential encounters. FCT provides a forum for public debate that has the potential to move individually held positions towards synthetic public values useful for governing scientific and technical futures.

### **CASE 3: pTA AS PROPAGANDA - FINDING FUTURES IN THE CITYSCAPE OF LISBON, PORTUGAL**

Whereas in the eotechnic phase one conversed with the mirror and produced the biographical portrait and the introspective biography, in the neotechnic phase one poses for the camera, or still more, one acts for the motion picture. The change is from an introspective to a behaviorist psychology... (Mumford 1963, 243)

Such a picture about our lives, about our struggle for collectives, we never saw before. Your picture is absolutely true to life. When we saw it, we were reminded of our own collective farm, our own mistakes. We saw ourselves on the screen.

- Quote from a Russian peasant viewer of a film produced by Medvedkin's film collective on the Cinetrain (Leyda 1960, 332).

As I have covered in Chapter Two, Mumford asserts that materials themselves change human perception and, in megatechnics, have mediated the role of regimentation and measurement in society. The mechanization privileged scientific and technical explanations of the world. Glass took the shape of lenses for cameras that made snapshots and motion pictures. Through these manipulations of glass into technologies, our private lives are revealed in public. This final case explores this intersection of urban life, civic behavior and an experimental pTA called “Finding Futures”. In this case I posit that photographs as material props can capture aspects about a city dweller’s everyday experience that take advantage of the photographer’s tacit knowledge. Visual ethnographer, Sarah Pink (2011), describes how amateur photographers, whose photographs, when represented as a collection, constitute an urban identity in the national and international context. Ethnography, photo taking, using the visual sense to apprehend one’s environment is “place making” (Pink 2008).

This second case involves the cityscape of Lisbon, Portugal. This vignette centers on the question “how can we design interventions which allow publics to define the systems and technologies of greatest concern?” This case involves examining material artifacts produced from a pTA event: image and textual data created by conference goers who participated in an experimental workshop centered around an examination of technology in city of Lisbon, Portugal. The workshop, known as “Finding Futures,” was conducted on the occasion of a Science and Technology Studies workshop in 2011: a European Commission workshop on ‘Science in a Digital Society’, and took place in Lisbon in May. The Finding Futures Project takes as its starting point William Gibson’s

notion that ‘the future is already here, it’s just not very evenly distributed’, asking workshop participants to walk the city streets and record impacts of the past and present upon the future of the city with their cameras and digital phones. In Lisbon, the location was the old industrial district along the river Tejo, the longest river on the Iberian Peninsula and the source of drinking water to most of central Spain, including Madrid, and Portugal, and is harnessed by dozens of hydroelectric stations generate power. In Lisbon, tourists were asked to be attentive to “what these pasts might become.... Spot signs of the times ... [Identify] the future breaking through” and to take digital photographs.<sup>15</sup> The images were then uploaded to the photo-sharing website Flickr, tagged with ‘lisboafindingfutures’ and either ‘past’, ‘present’ or ‘future.’ Participants added a caption explaining their thoughts, memories or associations as they took the photo.

The work in Lisbon culminated in an installation viewing of the three streams of images, with each stream – tagged ‘past’, ‘present’, or ‘future’ – projected onto a separate screen in a triptych. An image from the collection appeared one at a time, scrolling across the screen on an off from left to right. While each image was active, its caption also scrolled across the bottom of the screen. The event culminated in a reception and installation that ran for several hours at the end of the ‘Science in a Digital Society’ workshop. Participants – and other workshop attendees – moved through and around the space and the screens onto which were projected an ambient stream of images and captions. A few people reclined on the floor to watch, while others, holding a glass of

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<sup>15</sup> The full guide to the walk is available at <http://sci-ict.jrc.it/?p=29>

port, stood as in a museum gallery, to watch and catch a glimpse of a photo that was unfamiliar, or perhaps of a photo they had taken personally. These moments with the collection of captured images turned a private moment where the tourist takes stock of a new city into an experience that could give onlookers a sense of the collection of images and observations.<sup>16</sup>

My analysis here uses the image and caption collection from the experimental Finding Futures Lisbon tour to examine what tourists noticed in the built environment that connoted future states involving technologies when they are given minimal direction about what features to notice. In specific, I examine the images and captions that participants associated with “futures.” The use of image taking as a medium for apprehending and interpretation of participant experience in a participatory action research context is akin to a methodology known as photovoice (Gubrium and Harper 2013). Practitioners put cameras in the hands of people as a participatory action research technique that empowers marginalized communities.

Methodologists Wang and Burris associate three goals with the use of the technique:

- 1) To enable people to record and reflect their community’s strengths and concerns
- 2) To promote critical dialog and knowledge about important issues through large and small group discussion of photographs, and
- 3) To reach policymakers (1997, 370).

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<sup>16</sup> This description of the Lisbon tour and photo exhibition is derived from (Davies et al. 2013)



The act of photo taking in Finding Futures is in effect ‘education for critical consciousness’ that aims to build capacity among project participants to imagine future states of the city they tour. The goal is to heighten awareness of the role that technological infrastructure plays in everyday urban experience (Wang and Burris 1994).

My analysis of the artifacts of this experimental TA technique using photography to make sense of the urban technological landscape in Lisbon, Portugal, provides empirical evidence about how TA that begins with participant observations and concerns might look. I examine patterns of individual and collective sense making in a media analysis of the text captions and in the associations of captions with particular images. Grounded in the artifactual analysis of this case, I use this experiment to further articulate how TA that incorporates experiential components for the purpose of agenda setting might be designed through the analysis of artifacts alone. This emphasis on the artifacts of a deliberative experiment diverges from traditional analytic approaches such as photovoice, which see photos as an intermediary, aiding interactions between and among research participants and empowering community members.

The use of photography as an ingredient in deliberation is an important element in case two of this chapter where I examine a pTA that integrates participant photography into a dialog session. Here, in a focus on the material artifacts of the Finding Futures experiment, I reflect on the material presence of the photographs as independent actants in pTA. I discuss the potential pull that these images of details in urban settings and technologies might have on the perceptions and collective understandings of the

photographer and viewer. Inanimate photos as evidence of conditions in cities may have significant influence on how citizens set agendas.

The process of recording evidence with photographs is familiar to Finding Futures conference goers. By evidence I mean insurance claims are filed with photos attached; forensic photographers visit the scenes of crimes; and families take innumerable pictures of their children's first birthday party. Given how influential photographic evidence can be in decision-making contexts, even in "bottom up" citizen agenda setting, both the positive and negative potential of material components of new deliberative models should be acknowledged and explored if the photographic medium is to be used appropriately in pTA.

Calling out one of the conclusions from Chapter One – the idea that crowds and things inherently resist - I ask "in what way does the photograph as an instrument of resistance aid the photographer and represent her viewpoint?" At the same time I recognize Mumford's insight about the transformative resonance of materials and the insight from the quote which initiates this case. Posing for the camera impacts our culture's behavior; the photograph influences the perspective of the photographer in ways she did not intend.

To discover the beneficial aspects of photography as an element in a deliberative process and as an input to pTA as *bildungsroman*, we must also inquire into the inverse. I consider the case where the photograph obscures, hinders, or blocks the creativity of the photographer when she is asked to capture an image that is suggestive of future states.

Davies et al reason that given the “co-development” of technology and society in cities, participatory processes should formalize these competing pressures of the material and social into deliberative processes (2012, 352).

In this light, I take up the analysis of a selection of images and captions in the Finding Futures experiment in order to establish the role of the photographic medium in citizen-set agendas in pTA. I ask whether photography can aid a bottom up agenda setting process to establish future scenarios against a backdrop of photography’s role in propagandizing. Are participant photos shared collectively in a dialog setting a form of agitprop?

### ***Photos as Propaganda***

“Agitprop, short for *agitation and propaganda*, was a communist theatrical genre in interwar Europe, largely scripted and performed by amateurs, designed to inculcate communist values into the consciousness of workers” (Merriman and Winter 2006). Agitprop began during the Russian civil war between 1918-1920 following the Bolshevik Revolution. During this period, trains traversed the countryside bringing musicians, performers, posters and broadsheets to entertain Russian peasants with scripted theater pieces that delivered simple ideological messages about working-class and private life (Stark 2012). Various troupes developed and traded scripts for the skits outside of central party control.

Later, in the 1930s, a little known cinematographer and worker named Medvedkin received resources to gather artists and filmmakers and to run his own mobile film workshop in the tradition of Agitprop. The Cinetrain, as it was called, contained complete post-production facilities, animation stations and a large laboratory. Though no films remain, the Cinetrain traveled thousands of miles through the Russian countryside and with the aim to depict activities of the newly created agricultural collectives and their grain harvests, steel mill production, and other seminal sites of the industrial revolution in Russia. Medvedkin's crew filmed inside these workplaces. The crew's main objective was to illustrate the achievements and the errors of agricultural and industrial production by filming such practices, ultimately using the films as educational and critical tools for improvement (Marker 1997; Schnittke et al. 1993).

Organizers of Finding Futures, a walking and photography tour of approximately twenty five conference goers at the European Commission workshop on 'Science in a Digital Society' had a much more exploratory mission on the day of their walk along the river Tejo. Conference attendees, who were members of the European Research Council, science policy, and Science and Technology Studies researchers and many, though not all, were tourists in Lisbon. A conference organizer took the group out into the city of Lisbon for three hours on a route that took us through renovated factory districts, waterfront parks, and connecting urban spaces. Some of these places were not on the usual route for tourists. Participants had simple instructions to find and photograph technologies of past present and future embedded in the urban landscape. Being that this event was conducted as a part of a conference, participants viewed it as a social

icebreaker and many walked together in groups or pairs. However, other participants chose to do the exercise in a solitary manner, walking and using the camera to look privately at details in the cityscape. Next I outline the criteria of my media analysis of the photos collected from the walking tour that had been tagged “future.” I selected the “future” group to investigate whether photos associated with Lisbon’s future would be the most likely to reveal participant aspirations and be the place where photos as agitprop might be most clearly identified.

### ***Methods and Data***

I separated out the future images and grouped them into thematic categories based on what was physically depicted in the picture. Within the thematic groups, I examined the captions and assigned a positive, negative, or neutral value to the caption’s meaning overall. I then took note of whether the caption addressed the content of the image directly or whether it made reference to other ideas or concepts indirectly associated with the material objects shown in the photograph. Based on the patterns I observed through this parsing of the collection I discuss the value statements most commonly expressed in the collection and consider these statements in the context of the tradition of agitprop.

There were forty-three images total that were tagged “future” that also had a caption. There was a breadth of types of things that participants associated with future technologies in Lisbon. The types of things depicted in the pictures can be separated into twelve distinct categories shown in this table. The table is split into two columns showing those categories with the greatest frequency in numbers of pictures at the top. The

categories in the left column are those with captions that were primarily positive and in the right column, are the primarily negative captions.

Table 3: Image Coding

<b>Majority Captions Positive</b>	<b>Majority Captions negative</b>
Windows and Doors/ shop windows <i>(5 images, 5 positive)</i>	Language <i>(10 images, 4 positive, 5 negative, 1 neutral)</i>
Food <i>(5 images, 3 positive, 2 negative)</i>	Infrastructure <i>(6 images, 2 positive, 3 negative, 1 neutral)</i>
Transportation <i>(4 images, 3 positive, 1 neutral)</i>	Surveillance <i>(3 images, 3 negative)</i>
Art <i>(3 images, 1 positive, 2 neutral)</i>	Refuse / Garbage <i>(2 images, 1 positive, 1 negative)</i>
Nature <i>(2 images, 1 positive, 1 negative)</i>	Device <i>(1 image, 1 neutral)</i>
Communication <i>(1 image, 1 positive)</i>	
Love <i>(1 images, 1 positive)</i>	

Participant “technology tourists” on the walk by river Tejo took photos of signage, what I term “language”; shop and building windows and doors; representations of food or restaurants; and infrastructure such as roads, bridge, overpasses and abandoned, fenced lots (what I call “infrastructure”) most frequently. Over half of the phenomena depicted in the photos belong to these four categories.

The category “language” stands in for legal proclamations in the form of official signage that governs everyday street life such as parking and indicating public services. This category represents expressions of broader government and legal regimes in cities such as business and residential zoning. There is also unsanctioned language in the form of graffiti, fliers and street art, which are plentiful in Lisbon that depicts public expressions of citizen’s political views, values. These signs report community initiated events, gatherings, and commerce. These unsanctioned expressions of language displayed in public, as with the official signage, link to local knowledge of communities, neighborhoods, social and interest groups that tell us about the interests and values of the city’s residents.

I move now to discuss how I coded the relationship between the categories of things represented in the image collection tagged “future” and the captions that photographers applied to these images. I coded each caption as either “convergent” or “divergent” with its image content. By “convergent” I mean that the caption refers directly to a material object depicted in the image. An example of a convergent caption is” one day CARRIS (the bus transport system in Lisbon) will be just a museum” applied to a photo of a bus stop schedule affixed to its pole on the street. “Divergent” means that the caption describes something altogether different than what is depicted, connecting the context of the material image to a broader context. A divergent caption reads” Lisbon - no more work.” It refers to an image of the inside of a large former factory building. The majority, seventy percent or thirty-one of the caption relationships are convergent, with twenty seven percent, or twelve captions that, in contrast, express divergent meanings.

## *Discussion*

In this media analysis of participant photographs and captions in the Finding Futures pTA experiment, I view the material presence of the photographs as independent actants. The image caption relationships then as convergent or divergent provide a simple gauge of whether the photographer's stance is descriptive or proscriptive. Like the intentions of Medvedkin's film crew on the Cinetrain, participant captions reveal an impulse to see and represent faithfully what is happening in the photograph. In the Finding Futures pTA as in the Cinetrain films this impulse to show current conditions in the city is coupled with the (propagandistic) intent to suggest how to improve upon (in the case of positive captions) or warn against (in the case of negative statements) future developments.

I translate the convergent and divergent caption meanings into loose categories of positive or negative value statements (depicted in **Table 3**) in order to think about the value of the photographs as an ingredient in pTA dialogs and how diverse and contingent caption meanings are relative to established social, legal, ethical and political statements. Citizens either support, amplify, or denounce these social conditions by capturing a photograph and making a brief statement through the caption to demonstrate what that encounter meant to him or her.

I have discussed the image and caption relationships and linked convergent and divergent meanings with propagandistic intentions. In the main, invoking the term "propaganda" invites a host of negative associations that stretch back in history around



the world in examples where governments, dictators, corporations and other interest groups make public statements, often mediated by images, film and other messaging, with the intent of influencing public opinion and behaviors. The agitprop trains of the Russian Revolution certainly epitomize this view. However, for Medvedkin, who recreated the form in the 1930s and for our small pTA experiment, the pivotal question becomes “who has created and promoted public values statements that might be labeled as propaganda?” In the Finding Futures case, the collection of photos reveals how this set of participants viewed the future of Lisbon and technology’s place in it. The “propaganda” constructed here is the result of bottom-up, or crowd sourced ideas, associations and messages. When a pTA organizer attempts to represent collective public values, he or she must be aware of the degree to which the results of a given engagement activity are a form of propaganda that has the potential to influence the thinking, action, and decision making of others. pTA designers interested in experimental methods will need to account for places where existing technologies, systems and the built environment unduly influence or constrain the thinking of participants who are trying to envision alternative future states. In my analysis this perspective shows up in the convergent image and caption relationships. pTA researchers should also be attentive to the inverse case, illustrated in the divergent image caption relationships here, where personal dynamics and ideological beliefs may obscure the task of seeing and evaluating material conditions and of translating those findings into value statements that are useful contributions to a public dialog.

Finding Futures was a small-scale pTA experiment organizers conducted to understand by what mechanisms and activities could photographers in an unfamiliar city identify technologies in the landscape that elicit value statements in the photo captions. A simple proof of concept exercise, Finding Futures deals with only one component of what would make for a robust pTA dialog. Our participant group was far from representative of citizen of Lisbon; these were conference participants very knowledgeable about issues associated with science technology and society. This fact highly limits how portable this analysis of photography as an input to public dialog about technologies might be with other groups of citizens and stakeholders. However, as the Medvedkin example and the photovoice tradition show, these techniques have been used with many different kinds of people and communities to tap into tacit knowledge and to define community concerns.

### **pTA AS *BILDUNGSROMAN***

I shall develop the view that man is pre-eminently a mind making, self-mastering, and self-designing animal; and the primary locus of all his activities lies first in his own organism, and in the social organization through which it finds fuller expression. Until man has made something of himself he could make little of the world around him. (Mumford 1967, 9).

Mumford's organicist view confounds the idea that complex material technologies signal our sophistication in the world. Instead, the development of mind and creativity is central. Modern society, Mumford diagnoses, through the rationalized methods of science has wrought a rigid, mechanized collective structure that has forgotten to place creativity and mind as a central concern of living, working and producing. Based on this idea of the relationship between collective human capacity and

technology, Mumford diagnoses modern society as one driven by the “megamachine”, in order to undermine the hard determinist view that technology development involves a linear path of continuous improvement and progress (1963). Mumford describes the cyclical rise and fall of human capacities to sustain megamachine-like organization that, at different points in history, drive human accomplishment.

To bridge theory and practice in the three empirical cases I report on here that experiment with today’s dominant pTA forms, I return to the concept of *bildungsroman*, a “novel of formation,” known in literary studies as a narrowly constrained German genre while paradoxically emerging as a “universal expression of modernity” (Boes 2012; Moretti 1987). Classically, this sort of novel traces a young man’s personal growth into maturity “abandoning provincial roots for an urban environment to explore his intellectual, emotional, moral, and spiritual capacities” (Schellinger, Hudson, and Rijsberman 1998). Literary critics complain that the genre is confining in the sense that it presupposes a conventional white male protagonist who through a series of misadventures, passes into maturity.

The genre has not remained a footnote, however, referring merely to a short library shelf of German 18<sup>th</sup> and 19<sup>th</sup> century novels. Instead, the idea and aesthetic of the “coming of age” story is embedded as an idea in popular culture. It is the story of innovation and progress as told through the lens of the social. In fact, the genre has proven so irresistible that one scholar claims it is the symbol of modernity itself in its depiction of the self and society in the process of change (Moretti 1987).

Originating as a religious term, “*bildung*” has a rich and untranslatable lineage. The word conjures a variety of aesthetic connections in variant translations “image”, “painting”, “figure” and “trope.” *Bildung* identifies “a process of self-formation over the course of which the self, spurred by external circumstance, develops its own internal resources and forms itself harmoniously, in some respects as an artwork. Education can and usually does have all sorts of practical, accidental, and coercive aspects to it, but *bildung* connotes an ongoing, gradual, nonviolent, and non-instrumental process of self-fashioning” (Redfield n.d.). It is this idea of self-fashioning in conversation with “external circumstance” that I adopt to give a distinctive name to the way collective capacities can innovate with the aim of social development in concert with but not driven by technological innovation. It is this external circumstance that this chapter and its empirical cases unpack to identify how the material and experiential contribute to collective development in the tradition of *bildungsroman*.

This view of pTA interprets its chief aim as one that promotes social learning. Jasanoff and STS scholars interested in knowledge claims have put this concern in terms of the development the capacity of collective reflection: "rather than seeking monocausal explanations, it would be fruitful to design avenues through which societies can reflect collaboratively `on the ambiguity of their experiences, and to assess the strengths and weaknesses of alternative explanations" (Jasanoff 2003, 242). Researchers at the Center for Nanotechnology in Society at Arizona State define capacity building as “the ability of a variety of lay and expert stakeholders, both individually and through an array of feedback mechanisms, to collectively imagine, critique, and thereby shape the issues

presented by emerging technologies before they become reified in particular ways” (Barben et al. 2008, 992). Social learning is important in the context of ideas about the democratization of science. If in fact, as a number of STS scholars have shown, technoscientific knowledge is a major source of political, economic and cultural power (Blok 2007; Blok 2011), democratizing this knowledge is an important liberating action (Sclove 1995). pTA is designed with this assumption in mind.

Framing pTA as *bildungsroman*, an experiential process of collective self formation in direct conversation with society and its technological systems, suggests a way forward for directing the design of pTA towards the emergent qualities I have identified in Chapter Three to recognize and distinguish both the creative and the destructive qualities of crowds in the process of transformation as I have revealed at length in Chapter Two. *Bildung* is at the heart of STS ideals about the benefits of involving citizens in the evaluation of different scientific and technical futures.

Even as the STS community has been optimistic and industriously advocating for pTA in theory and in practice, there is also a similarly active criticism in the community of experimental forums. Participation may add up to clever social engineering or market research. Laurent (2011) identifies a number of potential tensions created by different public experiments used by scholarly experts and others who mediate science and publics around the issue of nanotechnology, and the particular publics these construct (Laurent 2011; Mohr 2011; Wynne 2014). Just as in the political science and policy literature in the focus on small-scale activities and mini-publics, Bandelli and Konijn (2012) are critical about the ramification of isolated PES programming. They find that PES activities

are “incidental” to larger institutional decision-making processes and that changes in programming have not resulted in changes in institutional governance or in the nature of the design of future content or programming. These two authors call out an assumption in the progression and analysis of the development of deliberative systems, asserting that particular small-scale pTA might influence whole systems behavior over time.

I do not see the experiments in material and experiential engagement evidenced in the cases in this chapter as ends in and of themselves; these experiments represent new territory in material deliberation (Davies et al. 2012) not traditionally covered by theorists of deliberative democracy or scholars of technology. These three experimental pTAs represent different interventions, institutional and physical arrangements that build deliberative capacity. Davies et al (2009) argue that exploratory dialog events that don’t aim at changing policy have the potential to 1) empower people to engage further, 2) that the forum participants perceive them as personally beneficial and 3) can contribute to cultural relations between science and society. But these innovations cannot stay in their niches (Seyfang and Longhurst 2013); concomitant research and practice must render these engagements more common in civic life. pTA design must be complimented by new approaches for governance that invoke what Joseph Nye (1990, 2011) has called ‘soft power,’ or the ability to attract rather than wield force.

Deliberative democratic theorist, Dryzek defines deliberative capacity as “the extent to which a political system possesses structures to host deliberation that is authentic, inclusive, and consequential.” He notes that deliberative capacity does not

prescribe particular institutional forms, but instead involves connection with “different sorts of institutions and practices” (Dryzek 2009, 1382). While much of the discussion of formal TA processes hones in on the question of deliberations that have the potential for direct policy impact (and often finds these processes lacking), the concept of deliberative systems opens up the possibility of not only looking for impact in other parts of civic life, but also asserting the necessity of these other scaffolds in public and private life to support deliberative democratic habits. I will discuss these in more depth in the concluding Chapter Five where I introduce the Soft megamachine as a framework.

While identifying important parts of deliberative systems might bring many practices, informal, inadvertent, and legacy into the frame, my work focuses on the intentional structuring of deliberative pTA experience as social learning as *bildungsroman*. The empirical parts of this chapter have examined deliberation in informal science education and academic research settings. In the fourth chapter, I examine the activities of founding members of a new social movement that questions the outcomes of innovation as progress through the lens of fossil fuel addiction. I address the issue of the scale of interventions needed to make significant sociotechnical changes to the terms that currently inform the contemporary megamachine. I examine the early stages of the formation of a new environmental social movement called the Transition Initiative (TI) whose members are attempting to reorient social processes around different collective capacities.

## Chapter 4

### EMERGENT TECHNOLOGY ASSESSMENT

Nothing could be more damaging to the myth of the machine, and to the dehumanized social order it has brought into existence, than a steady withdrawal of interest, a slowing down of tempo, a stoppage of senseless routines and mindless acts.

(Mumford 1967, 433)

I agree with Mumford, that the crowd behaviors, or collective capacities, that give us the terms for scientific and technological innovation under the megamachine marginalize other ways that crowds, as a metaphor for an innovating sociotechnical society, might behave. Conditions for the megamachine are held in place by a powerful combination of routines in labor; specialization of interests and training; management and governance by institutions; categories and hierarchies of knowledge; and the instantiations of these social forces in material form through technologies, systems, and goods. I disagree with Mumford, however, on how a definitive turn away from the megamachine can gain momentum.

The quote that initiates this chapter comes from the epilogue in the final volume of the *Myth of the Machine* series. Here Mumford attempts to put an optimistic spin on the most pessimistic of his writings reflecting on the prospects for changing the conditions for the megamachine, improving the terms for human and ecological living. In an uncharacteristic move that runs counter to his argument about how the megamachine works, Mumford (1970, 433) appeals to individual will to provide the muscle that will be required to turn away from the megamachine, claiming that this agency lies within the “province of each individual soul.” Given his own admissions about the influence of



mechanized collective capacities, Mumford does not provide an adequate strategy for how individuals can thwart the totality of human and non-human forces that move them to perpetuate the megamachine.

Eight years after the publication of that final volume of *Myth of the Machine*, Langdon Winner (1978) offers a psychological approach to the issue of how people can “withdraw interest” from technological arrangements by outlining a method he calls “Luddism as Epistemology” (EL) in his book, *Autonomous Technology*. While the original Luddism involved the actual destruction of weaving looms by angered workers who realized that machines would replace them, the epistemological version furnishes a way for dissenting individuals to examine the existing sociotechnical landscape critically and interrogate the kinds of ideas that keep these conditions in place. This process involves taking an intentional hiatus from technological systems not as an end in and of itself (“dropping out”). Instead, Luddism as epistemology is a means to impose a perspective shift that allows us to take stock of systems we are embedded in, recognize their component parts, and notice what we miss when we don’t use, maintain, or monitor them. In line with Mumford’s focus on human capacities, Winner (1978) thinks the “technologies of most concern are actually forms of life – patterns of human consciousness and behavior adapted to a rational, productive design” (331). He speculates that EL can be applied as a method to catalyze a structured examination of the “human parts of modern social technology.” Winner thinks that such a method can help define the nature of human dependency on systems and pinpoint the ways that technological systems change human relationships and everyday environments, rendering

them uniform, routine, scientific and divorced from mediating value judgments (Winner 1978, 331). Though Winner takes Mumford's prescription a bit further, I still think Luddism as epistemology is inadequate because it fundamentally depends upon individual agency.

In laying out how collective capacities matter in creating sociotechnical relationships and connecting this framework to TA in this dissertation, I formulate a more complete answer to how collective capacities can go beyond merely reproducing the conditions for the megamachine over and over again. We must develop social processes at all levels of society that allow for pTA in the broadest sense to interact meaningfully with the collective capacities of the crowd; indeed the ability to self regulate must itself become a collective capacity. To do this, at the very least, pTA should be a common, rather than a rare opportunity for citizens to have input into otherwise technocratic decision-making. Parkinson and Dryzek (2009; 2012) assert that institutional and social supports for reflexivity as “deliberative capacity building” are what is needed to create routine demonstrations of democracy like pTA. There is cause to be skeptical about pTA processes themselves, however. Bryan Wynne (2006) charges that public engagement processes can themselves enroll people into particular sociotechnical relationships. Irwin (2014, 71) reflects “the ambiguous character of the institutional embrace of social science and the instrumental role accorded to PES research remain as significant issues.”

Ironically, in order to try and influence policy directly, organizers of TA have oriented dialog processes to respond to near term requests and specific technologies, to use scientific evidence, and to privilege rational discourse and expertise. Deliberative

democratic theorists Sanders (1997) and Young (2000) suggest that deliberation based solely on rational discourse is in effect elite and undemocratic because of the modes of communication it omits. In emphasizing these features to the exclusion of other important social ways of knowing and expressing value, TA misses opportunities to draw from other talents, generative and destructive, present in collective capacities. Affective, material, and experiential knowledge are not commonly incorporated into deliberative fora and thus opportunities for steering innovation, developing governance mechanisms and taking advantage of the social resilience that can be generated by emergent practices are not fully realized. I have thus far examined select experiments of isolated pTA that incorporate alternative and experimental techniques for tapping tacit knowledge and encouraging emergent capacities. As I have reviewed earlier in this dissertation, scholars interested in deliberative democracy have followed small group dialog processes with interest, in the tradition of Dahl's idea of the utility of "minipopulous" supported by experts, administrators and stakeholders as a form that can reinvigorate democratic processes (1989, 342). By orienting my analysis in the previous chapter around experimental techniques for public engagement that provide affordances for affect, experiential and tacit knowledge in the context of minipublic dialogs, I affirm the utility of aligning pTA design to take full advantage of the abilities of the sociotechnical crowd.

To accomplish this, organizers of pTA must entertain new designs for and new kinds of dialog processes. However, a gaze trained on organized processes of deliberation alone runs the risk of missing the significance of bottom-up, grassroots engagements with science and technology, such as those found in activism and protest, civil movements, or

user groups and consumer organizations (Bogner 2012; Seifert and Plows 2014; Selin et al., n.d.; Wehling 2012). Architecting small-scale minipublics alone cannot produce pTA as *bildung*, or widespread social maturation in society.

## **COLLECTIVE CAPACITIES IN THE TRANSITION INITIATIVE**

In this next section, I confront the issue of the scale of interventions needed to make significant changes to the terms that give us the contemporary megamachine by examining the early stages of the formation of a new environmental social movement called the Transition Initiative (TI). Members of TI are attempting to reorient social processes around different collective capacities. I use this case to reflect on whether “the crowd” can “back slowly away” (as Mumford recommends at the end of *Pentagon of Power*) from the excesses of technological innovation on its own initiative. I call this *Emergent Technology Assessment (ETA)*, or the possibility of new sociotechnical relationships through a process of collective social change, rather than assessment targeting specific technologies or issues. I investigate where else these kinds of reflexive qualities might develop outside of an instrumentalized process run by academics. The TI movement is an example of a social movement that is taking steps to reorganize society based on principles of local resilience, where communities seek to prioritize energy and economic production at the scope and scale appropriate for the sustenance of its immediate members. While the case I select does not provide unequivocal evidence that small-scale shifts are blueprints for systemic change, my choice to focus on the activities of grassroots activism connects lessons learned in the context of a bottom-up attempt to

shift public priorities to new models for public policies that can encourage emergent collective capacities.

This study examines the major ideas motivating the leadership of a new environmental social movement, the Transition Initiative (TI). Members of TI strive for localization, community resilience, and strive to reduce energy use across their cities, villages and towns in response to climate change, peak oil, and economic conditions in decline. On the whole, TI members are middle to upper class white citizens who have been active in environmental organizations but are seeking a new and pragmatic approach to sustainable lifestyles. Adherents acknowledge socio-technical systemic problems like climate change and strive to adapt social and environmental practices rather than advocate overtly for political change. TI members are concerned that societies will need to change in direct relation to the consequences of climate change, peak oil, and a global economic downturn.

I assert that these ideas of near-term systemic risk form the basic framework for how Transition members problematize various aspects of the contemporary sociotechnical situation. This perceived risk framework forms the precondition for the invention of so-called “social technologies” employed by Transition groups to produce a systemic critique of the established sociotechnical order. At this early stage of development of the movement, it remains to be seen whether alternative TI activities built upon heterogeneous understandings of the dynamics of society and nature can inspire significant and sustainable changes in socio-technical relationships. I hypothesize that particular epistemic arrangements that inform TI member activities lay the groundwork

for a kind of ETA, or the ways in which collective social aspirations can drive sociotechnical innovation.

While the TI outreach to gain new membership articulates a strong set of ideas that “brand” the movement, the empirical work reveals that members possess variant understandings of TI ideas and also place different emphasis on aspects of those ideas. My conversations with individual organizers across ten TI groups bring into focus three distinct understandings about the nature of society’s relationship to the environment that reflect traditions in social theory. These traditions include 1) limited resources (Foster 2000; Leiss 1994), where a condition of resource scarcity is defined as the motivator of policy change; 2) “uneven geography” (Harvey 2000; N. Smith 1984), where unequal economic conditions derive from variations in geographic, technological, and political conditions and lead to different policymaking regimes; and 3) “the pastoral” (Cronon 1996; Marx 1973; Nye 1994), an aesthetic and supporting set of governance mechanisms that maintain a historical imaginary about cultivated nature based on a agrarian past, obscuring contemporary resource vulnerabilities.

This ontology and its three ways of characterizing the relationship between humans, available resources and the natural environment depend upon the intersection of received global scientific and technical knowledge. This is knowledge that has been produced, legitimized, and propagated through global institutions to distributed groups of citizens concerned about three complex and interacting phenomena: climate change, peak oil, and economic collapse. Climate change concerns the state of the global environment; peak oil refers to the idea that global oil production has reached a plateau and will

become increasingly more difficult to extract. The concern about economic crisis is based on the recent global market instabilities of 2009, but also is compounded by an understanding that the first two factors will interact to produce volatile economic conditions in the near future. These collective ways of understanding map onto an ontology, or means of categorizing, social theoretic traditions in the interpretation of the domination of nature. While TI outreach to gain new membership articulates a strong set of ideas that “brand” the movement, my empirical work reveals that members possess variant understandings of TI ideas and also place different emphasis on aspects of those ideas.

The Transition Initiative (TI) is a small but rapidly growing environmental movement. Adherents acknowledge socio-technical systemic problems like climate change, peak oil, and the prospect of systemic economic collapse and strive to develop social and environmental practices (rather than political change) that allow for adaptability in a changing environment, namely localization, community resilience, and an intentional decline in energy use (Barry and Quilley 2009). The movement officially began in 2006 in Totnes, Devon, UK and spread across the UK. It now has outposts in forty-three countries. At this writing, there are one thousand one hundred and thirty registered groups on the main Transition web space, four hundred and seventy seven “official” groups worldwide. TI planning re-imagines social and behavioral routines now dependent on fossil fuels for sustaining food, transportation, shelter, energy, and economic systems. These groups see the familiar oil economy that shoots through every

aspect of our everyday lives as an unsustainable and undesirable way of life, one that adherents claim is certain to come to an end in the near future.

My work with TI categorizes the kinds of knowledge that lead TI members to back away from the dominant cultural practices founded on a fossil fuel economy. I assert that these ideas set the stage for understanding potential ontological conflicts in the knowledge that motivates the Transition movement. Ideas and their variants that draw people to becoming involved in TI form the precondition for so-called “social technologies” that Transition groups use to advocate a systemic critique of established sociotechnical order in particular community settings and in different cultural and national contexts.

My empirical analysis centers on three questions: What makes people who are otherwise in good economic and social standing decide to form groups and articulate a critique of the status quo, effectively politicizing a space that is more or less working in their favor? What is the role of public knowledge in fueling and legitimizing this politicization for TI membership? And lastly, how does this social movement make meaning of the messages from science to synthesize a vision of the relationship between society and the natural world? I assert that TI members use one or more of these ecocritical traditions to validate and frame different interpretations of the main Transition messages about systemic risk. This variation explains the wide appeal and rapid spread of the movement globally. In the conclusion, I will confront the question of whether alternative TI activities built upon differing understandings of the dynamics of society



and nature can inspire significant and sustainable changes in socio-technical relationships and propose future work.

While the TI movement is still quite new, recent efforts underway to characterize membership in the US provide a snapshot of the current demographics of TI membership. Stanford University sociologist Paolo Parigi posts summary findings of a TI social network-supported survey conducted in 2010 on the Transition US NING site:

The survey showed respondents to be politically active, educated, white adults, with women making up 58% of the sample. More than half of the respondents have ever [sic] belonged to an environmental group or political/civic organization, and over 80% have attended a political/civic event. (2012).

I look at this characteristic in TI from a Science and Technology Studies (STS) perspective to characterize how ideas about established technological landscapes and their future designs affect this pragmatic approach. I am interested in collective behavioral change through community organizing rather than on the resistance that has characterized other environmental groups.

### ***Methods***

This chapter next reports on fieldwork conducted in 2010 with leadership of the Transition Initiative (TI). My interest is to understand what processes TI communities undertake routinely to plan practical activities in various areas identified by these groups as targets for building local resilience. Projects range from planting edible fruit and nut trees on public land to developing community owned and managed in local solar arrays. I conducted semi-structured interviews in ten communities with active TI initiatives: six in

the UK and four in the US. I spoke with a total of twenty-two individuals who organize TI groups and had informal conversations or email exchanges with an additional twenty individuals associated with each the locations I visited.

My interview guide is constructed based on an outline of the thematic topics to be covered and is meant as a loose roadmap, bounding the interview territory around socio-technical relationships [**Appendix B** contains the interview protocol]. Following Kvale's suggested structure for the interview guide, I outlined a series of four question themes to bound a semi-structured interview process: triggers for participation; "the Luddist move," referring to how TI activities encourage reflexivity; measures of system autonomy; 'forms of life' or artifacts of collective capacities in everyday life; and technological systems (1996, 129; Kvale 2008). I then list a companion set of interview questions for each theme that give a flavor of how conversational questions that support the dynamics of a successful interview align with higher-order research goals.

I employed snowball sampling, beginning my UK contact with opportune introductions to existing research contacts through two embedded UK researchers, Dr. Stephen Quilley (University of Keele) and John Barry (Queen's University Belfast) in TIs Richmond, Shrewsbury and Lancaster (Barry and Quilley 2009). I spoke with individuals based in the towns of Richmond, Lancaster, Durham and Brighton and Hove. I also conducted participant observation with leadership and organizational contacts at the Transition Network UK conference at Seale Hayne in Devon, June 12-14, 2010. This meeting involved approximately one hundred attendees from across the UK with some

international attendees. I conducted in-person or follow up interviews with group leaders where possible during and following this event.

In the US context, research involved a combination of participant observation of TI Tucson, Arizona, monthly meetings in fall and Spring 2010, and Amherst, Massachusetts, in Spring 2011. I conducted semi-structured interviews with TI leadership in Ashville, North Carolina; Hohenwald, Tennessee; and Sebastopol, California, and spoke with principals at the Post Carbon Institute, a think tank that provides financial support for the development of the US network based in Santa Rosa, California.<sup>17</sup>

While I covered considerable ground by observing several groups in the UK and the US, the interview method imposes limitations on what can be said about the links between the ideas driving participation in TI and the impact these ideas have on group activities related to technology change. I spent a limited amount of time with each group and in each community context. Further in-depth ethnography to provide thick description of how the epistemic patterns I reveal here translate into common practices and methods for employing technologies in various groups is needed to confirm my hypothesis.

In place of ethnographic data, I examine a formal report created by one of the first UK groups outlining a plan for what this group calls “community energy descent.” I use this community report as a proxy for the kinds of concrete actions this particular TI group intends to take. The report is a community-visioned and community-designed fifteen to twenty year plan that creates a coordinated range of projects in all these key areas, with

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<sup>17</sup> See <http://www.postcarbon.org/>

the aim of bringing the community to a sufficiently resilient and low CO<sub>2</sub>-emitting state. In the concluding section of this chapter I suggest that examining practices used in TI that derive from identifying knowledge orders amount to an *emergent technology assessment (ETA)*, or collective social change that in turn affects technology development. ETA as a concept illuminates the areas of pTA that might be improved upon by experimentation to include processes and approaches used by groups like TI attempting to motivate changes in social conventions rather than in particular technical regimes. ETA, then, becomes a strategy for combatting the systemic stasis that today continues to produce Mumford's megamachine.

### ***The Significance of the Transition Initiative as a Social Movement***

Many scholars have chronicled the development of environmental movements, their ideas and political platforms (Jamison 2001; Fischer 2000). Issues of pollution, environmental degradation, and issue framing on chemical pesticides and air quality catalyze these groups. Books like Rachel Carson's *Silent Spring* (1962) chronicle the major issues that have catalyzed the environmental movement. Over the past fifty or more years the environmental movement has developed mature NGOs, political lobbies, and other instruments to make its presence known in the political arena.

Despite a swell of action, interest and coalition building, many environmental activists encounter significant political defeats on the issues that they care about. Legislation, regulation, and new organizations created to monitor and steward the environment seem to fall short of radical goals for a spectrum of reasons, political and

practical. The more radical of these groups attempt to bypass established frameworks and governance structures to take matters into their own hands, much as the original followers of Ned Lud did, pledging to personally stop the workings of a machine or block the razing of a landscape by developers. So called Neo-Luddist groups formed in the early 1990s like *Earth First* and others work outside the system ("Earth First! Worldwide" 2010). The Neo-Luddist and Anarcho-Primitivist groups operative today share an "anti-civilization" stance: the idea that in the face of environmental and social injustices, groups should work to speed up what they see as an inevitable collapse of the civilized world as we know it (Glendinning 1990; Jensen 2006; Jones 2006; Sale 1995).

In contrast to these Neo-Luddist groups, TI distinguishes itself in several important ways. Hess writes about social movements that do more than resist technologies, but instead develop alternative pathways or adaptations for living with them (Hess 2007; Hess 2009). TI does not protest particular issues, nor does it (at this early stage in its development) attempt to form political lobbies or hierarchical administrative structures. According to the TI Handbook, communities progress through a four-stage process to realize Transition goals: first, a small initiating group raises awareness about the core Transition issues: climate change, peak oil and economic collapse. During this stage, the collective articulates a rationale for adopting/adapting a Transition approach. Next, as membership grows, each group self-organizes into working teams in key areas such as food, transport, energy, housing, education, textiles, etc. Members create practical projects in response to that big question (such as community supported agriculture, car clubs, local currencies, neighborhood carbon reduction clubs, urban orchards, reskilling

classes). Most Transition Initiatives are in this phase. Third, when the initiative is sufficiently competent with these concepts and practices, it embarks on an EDAP (Energy Descent Action Plan) process. This is a plan that creates a coordinated range of projects in all these key areas, with the aim of bringing the community to a sufficiently resilient and low CO<sub>2</sub>-emitting state. A very small handful of Transition Initiatives have embarked on this phase. Lastly, communities put the EDAP into practice.<sup>18</sup>

The Transition mission is to inspire, encourage, connect, support and train communities as they adopt and adapt the TI model on their journey to urgently rebuild resilience and drastically reduce CO<sub>2</sub> emissions. According to the Handbook and its leadership, the Transition model is built around the following set of ideas:

- Climate Change and Peak Oil require urgent action
- Life with less energy is inevitable
- Industrial society has lost the resilience to be able to cope with energy shocks
- We have to act together and we have to act now
- Infinite growth within a finite system simply isn't possible
- We demonstrated phenomenal levels of ingenuity and intelligence as we raced up the energy curve over the last 150 years, and there's no reason why we can't use those qualities [to] negotiate our way down
- [We] can use our creativity and cooperation to unleash the genius within our local communities (Brangwyn and Hopkins 2008, 8).

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<sup>18</sup> Text describing the phases adapted from <http://www.transitionnetwork.org/support/what-transition-initiative>

Initial group leadership of the TI process in their locations plan to step down over time to allow the ideas generated to disperse among participants and be influential more broadly in the community conversation (Brangwyn and Hopkins 2008). Barry and Quilley (2008, 13) note, “In many important respects the TI movement is an example of practical, solutions-orientated ‘sustainable communities’ in the making. Those involved in the TI movement, while not apolitical or against political activity (which marks other sustainability political organizations and movements), do nevertheless represent a decisive ‘pragmatic turn’ as it were within the politics of the transition to sustainability.”

### ***The Transition brand: meta themes***

In his analysis of collective action, Melucci ponders how a “we” is formed and observes that collective actors “create for themselves a unitary definition which reinforces, at least ideologically, their capacity for action”(1996, 383). An interviewee from the Post Carbon Institute, a think tank providing intellectual and financial support to Transition US, asserts that Transition has become a successful “brand” that renders the constellation of ideas it pedals to adherents easily recognizable. Part of the branding is aided by the materials the UK groups publish, as well as the web and social networking capabilities now available to decentralized groups like this one. In addition, however, TI offers an optimistic and creative vision of how to respond to a set of serious concerns about near future conditions on the planet and in society that bills itself as a pragmatic “how to” rather than as a political or environmental protest. The Post Carbon Institute

representative attributes Transition's optimistic orientation to the personalities of the key UK leadership:

My favorite thing about Transition is the cheerfulness thing, and that attitude and I think that Rob Hopkins' [founder of UK Transition] approach is that they wanted to imagine a better future and felt like that was really important to have people take action.... People fall in different buckets but there's this third bucket where there's the collection of people ... imagining life after the crash. That's sort of "head for the hills with your gun..." it's a very individualistic response.... Transition was the most optimistic [of the groups interested in these problems].

Discussions with organizers in two western countries from varying town sizes confirm that there are at least three significant meta themes about the public knowledge or civic epistemologies that become "received knowledge" among TI members.

Adherents believe that the three major systemic challenges of climate change, peak oil and economic collapse are indeed global in scope. These are issues that will be felt everywhere by all communities and can't be avoided. One interviewee likened learning about peak oil to the scene in the movie *the Matrix*, where Morpheus shows Neo two pills: a blue and a red one. If Neo chooses the blue pill, he can wake up in his bed and believe whatever he wants. If he takes the red one, he will see "how deep the rabbit hole goes." This pop culture reference narrates the epistemic "choice" that new members must make to take seriously the main tenants of the TI ideals. Another two interviewees describe the context of their work in this matter-of-fact way:

We're in the early stages of an irreversible runaway greenhouse effect. In theory you might be able to do something about it, but its too late, the politicians will never get there. Its not about mitigation, its about adaptation. [Geoengineering] is about "how do we harden up?" [It] is a complete waste of time and money. The planet is beyond saving. This is all the context, [our] work is actually massively under-appreciated and -understood.... we are beyond power generators, we have



to harden up the same way they tried to hardened up during the Cold War, that's my personal opinion, doesn't make me very popular.

Transition understanding fuses together the three systemic challenges to create a frame that is alternately utopian (e.g. "we will live more simply and be happier people" or dystopian (if we don't band together there will be terrible struggles over resources). This utopic or dystopic frame renders the entire contemporary post-industrial project available for critique by Transitioners. Many organizers reported absorbing the key ideas and suddenly feeling as if everything they do in their daily lives is objectionable. The everyday routine, built on an oil economy, reappears as alien and unsustainable. While the TI bills itself as an apolitical movement, this utopic/dystopic framing of the core ideas is the foundation for triggering a wholesale examination of the dominant social practices tied to the oil economy. This meta theme is at the heart of Transition's potential for politicizing socio-technical relationships that have not previously surfaced in environmental political debate.

The final meta theme in the treatment of public knowledge among TI members is the use of scientific and technical information to support, validate and explain the core challenges that will shape near future social, environmental and economic conditions for communities. As Jasanoff points out, science and its norms of rational presentation of evidence plays an important but not exclusive role in generating political salience in national comparisons. For example, Miller shows that the climate debate has been significantly shaped by the postwar globalization of politics (2004, 46). Therefore

knowledge is constructed through hybridization of scientific and technological and socio-cultural, institutional understandings.

Transition organizers gave examples of how each group adopted scientific and technological ideas or S&T expertise that legitimate the constellation of ideas that make up the TI brand. S&T knowledge or expertise is used to verify, incentivize, or provide context to the movement's activities. In a northeastern UK town, one organizer made a point of installing a new temperature gauge on his home thermostat during our interview. Members of this core-organizing group described how each had conducted energy audits in their private homes to help minimize energy use make changes to optimize efficient energy use. In other words, these organizers are making use of particular kinds of expertise and technologies to assist them in becoming more aware and proactive about personal energy use. This same group gave examples of individuals in their town that navigated local zoning and town council historic building codes to receive permission to mount photovoltaics on their roofs. In the UK south, one group was in the process of starting an energy cooperative to take advantage of green government incentives. Along this same line, TI members in a southern US town started an annual green energy fair, drawing corporate vendors of alternative energy products to the region in the hopes of building and sustaining local economic growth.

The integral role of public scientific and technical knowledge orders in the TI "brand" provides a framework to support a critique of the status quo by people who are otherwise in good economic and social standing, effectively politicizing a space that is more or less working in their favor. TI themes absorb, imitate, and call upon scientific

and technological knowledge and expertise, recontextualize it and, in effect, politicize socio-technical spaces that have previously been just part of the scenery. TI concerns point out many of the elements of industrialization that have become embedded (seemingly inextricably) in contemporary life in the developed world. These are elements that I have argued keep “slow violence” marching forward and consistently impacting the poorest around the world. Areas of the sociotechnical of most concern – where relationships between humans and non-humans are unexamined – are not contested spaces. In order to find examples of collective capacities that can produce results other than those under the megamachine, uncontested spaces will need to be examined and politicized wholesale.

While the TI outreach to gain new membership articulates a strong set of ideas that “brand” the movement, my empirical work reveals that members possess variant understandings of TI ideas and also place different emphasis on aspects of those ideas. To reveal the contours of this variation among TI members’ understandings of sociotechnical relationships with the natural world, I develop a typology of three different sorts of assumptions that group organizers make about the relationship between society and nature that reflect traditions in ecocritical theory.

### ***Limited Resources***

A group in northern UK has secured space in a shop window just across from a post office where members hang monthly displays about TI ideas. The group was just preparing materials for a new exhibit on electric cars to coincide with a speaker they were

inviting to present on the topic. One core group member expresses reticence at featuring the Hubbard's peak graph, which has become the hallmark for depicting global oil depletion.

But one of the problems that's just come up in the last few days trying to do the current window which is about electric cars and so fuels. [And the question is] do we put the peak oil graph in?

So when I printed out the graphs, I thought, "I can't just put these in the window" without maybe saying "this is what is going to happen, all of you" and this is the best of the bulge. So far [the window displays have presented helpful information about] if you are having problems with your heating bills as an old person, these are some good contacts, and what about going on your bike and its all very "your choice" and its about saying "the world could be better if we were doing this," its not saying "wake up, we are all going to be in a horrendous mess".... at what point are we going to turn around and say "if you haven't heard yet, things are going to change".

Group members in this town contemplate revealing one of the underlying major ideas in Transition in the public square: the idea that we are living in a time when oil will become more and more difficult and costly to extract. The Hubbard's Peak graph situates global oil production along a timeline, predicting a significant decline beginning in the year 2000 through 2050. This organizing group thinks that western civilization is fast depleting its resources, but it has not yet "gone public" with this view. The speaker is concerned about how to frame what some town citizens might consider inflammatory. The evidence to suggest that oil resources will soon be scarce forms the basis for many of the group's activities around using less energy. While other displays this group has curated talked about making alternate choices about energy use, this one insists that a limited global oil supply is a scientific fact and that communities must respond to this fact by taking action in their lives to adapt to this global environmental reality.

This vignette illustrates how an enduring concept about the pressure that limited natural resources places on society informs the way that TI members define problems. Thomas Robert Malthus (1798) establishes this conflict between society and the environment by situating the problem as one related to population growth in his *Essay on Population*. John Bellamy Foster unpacks Malthus' work of political economy in *Marx's Ecology: Materialism and Nature* (2000), a work that challenges the conventional interpretations of Marx's treatment of the natural world as a component of his theories of economy. Placing Malthus' work in historical context, Foster argues that Malthus presents human population growth as a pressure on natural environments as an empirical fact in order to satisfy theological, social and political motives. Malthus uses his brand of population science to suggest that an egalitarian society is not possible because of these natural truisms about population growth and limited resources. The mathematics Malthus uses to support asserts about both population doubling and agricultural production is unsubstantiated (Foster 2000, 96). Foster further reveals how this ideologically fabricated idea about population and limited resources gets incorporated into both Darwin's writing on natural selection and also in Marx's work on political economy.

Assertions about limited resources establish a tension between scale and resource use in human populations and the environment's capacity to provide essential goods and to spring back from the harvest of those goods. This same tension is embodied in Transition concerns about peak oil. Transition members believe this pressure to be a real underlying motivation for changing everyday habits. This concept points to how a particular understanding about the relationship between society and the natural world

informs ways the Transition movement would like people to change their relationships to the oil economy. For this UK TI group, notably a rural community with no commuter train service, full understanding of the TI project includes accepting the idea of peak oil. The moment of “going public” in the town square with this idea is crucial, and yet one of the more political the group has taken. Communicating the idea of imminent resource scarcity goes against many everyday practices of automobile and energy use that these townspeople have. Up until now, this group has built awareness and interest in TI ideas of localization through gardening, tree planting, and clothes swapping. Revealing peak oil as a motivator is a more risky move for the young group still finding its role in the grassroots. At the same time, this idea resonates for the group members. Many are old enough to remember or hear stories from family members about post-war rationing. Among the meta-themes, the scientific explanation of resource scarcity of oil supply aligns with this group’s personal experiences of scarcity as a result of political struggle. While at the time this interview was conducted, peak oil was a relatively unknown concept in popular discourse in the UK; this group felt affinity towards this idea in the early stages of the groups’ formation. They began to organize and prioritize activities based on this notion. For this group, peak oil produces a perspective shift that resonates with personal and cultural experiences within their own lifetimes.

### ***Uneven Geography***

Another group in the US South petitions UK Transition organizers to become an official Transition town. The caveat to becoming official is that this group chooses not to

endorse global climate change as an established scientific fact. Instead, TI in the small town of Hohenwald, Tennessee, with a population of around four thousand people, focuses on local economic development.

There was a core group of people who really wanted to meet... we called ourselves the green initiative.... We started talking the whole Transition town thing; the difference was for us... [Transition] was birthed out of the whole idea of peak oil and global warming. That is not us. Now, in this small town we are deeply religious, I mean there is a church on every corner.... we've got a hugely conservative population, we've got a liberal population. We've got those who are doing... what they are doing because of God, and we've got others who are saying, no I am agnostic and I am just doing this because it's the best thing for me to do, and so then we had the Farm, or the hippie population. And some days I would sit in these meetings and say "how did we all get in the same room together?" Early on we decided that we would not talk religion, and we don't talk politics.

Members strive to support local business owners, farmers, artisans and service providers; create quality and long-term local employment; and stimulate an economy that has a total and sustainable economic return. Members frame environmental concerns that might otherwise be driven by concern about global climate change instead by focusing on 'green' development as the way to improve the local economy.

Real world events enhanced support for this approach in the spring of 2009 when a one hundred year flood in the region cut off the town for several days. One core group organizer had just finished a project with a school group to inventory local resources in the town to create a resilience map and a set of measures to assess self-sufficiency.

At the beginning of the semester I gave the students a D-Day scenario. I said "pick a date"... and I said on that day something very cataclysmic [will happen] and [our county] is going to be complete cut off. How long can we survive? Think like an islander. That was the gist of the assignment. They researched how many

working farms there were, how many grocery stores, how much water. I contacted emergency management... and invited people to the classroom. I gave the phone book and said “who do you want to talk to?” The day after April 30, the day they picked, there was the 100-year flood that actually cut off our town for two days....

Among other vulnerabilities, the children discovered that there was only one remaining family doing multi-crop row farming near the town. The children estimated that the county had a three day food supply and less than two days of water. This organizer was quick to point out how effective the recent flood was in confirming this TI group’s concern for local resilience. She intimated that the ideas around global climate change aren’t necessary and, among the conservative townspeople, would throw up social, theological, and political barriers to enacting TI ideas.

This story illustrates another classic epistemological tension that stems from a mismatch of global and local concerns. Marxist geographers David Harvey and Neil Smith describe the inequalities in the development of capitalism as “uneven development” where unequal economic conditions derive from variations in geographic, technological, and political conditions (Harvey 1996; Harvey 2000; Smith 1984). Harvey analyzes how social movements in the global South respond to uneven development pressures by outlining three responses to the ubiquity of capitalism and modern society. Some movements reject the globalized industrial and technological frame in a kind of return to “the stone age.” Others embrace globalization and a universal view, while a third enacts a hybrid response where groups appropriate global concepts to allow them to fit in and interact within the capitalist system.



In the case of this particular southern group, members reject a key global scientific concept linking human economic and technological development to climate change. In doing so, they invalidate a particular conception of human impact on the environment in favor of a more salient local reality about resource sufficiency. The choice to emphasize this particular aspect of Transition ideas over others suggests that TI activities will develop differently here than in places where climate change is accepted public knowledge that motivates community action. The question is, does adherence to the letter of scientific details about climate change matter as the town plans activities to improve energy efficiency and localization? It appears that this town has been able to use TI ideas to generate new perspectives and actions that have even enrolled town officials. It remains to be seen, however, whether TI forms the basis for authentic sociotechnical critique, or if as Harvey and Smith suggest, the amendment this group has made to omit climate change as an organizing concern merely positions this group to continue making contributions overall to the global market system and its particular socio technical arrangements that TI as a wider movement is attempting to critique and reverse.

### ***The Pastoral***

The last scene emphasizes the importance of aesthetics motivating or, sometimes, subverting the movement's ideas. The local horticultural society of Shrewsbury has been going strong for hundreds of years in this picturesque English town. Like many rural towns in this region, one can traverse historic town centers on foot and encounter commercial stores selling provisions from hardware to foodstuffs. This town in particular

features an annual flower show and other local events to attract tourists. Shops and streets are aesthetically pleasing and hearken to an earlier, perhaps simpler, pre-industrial agrarian time (William Morris' *News from Nowhere* (1890) provides an operative frame). A fledgling TI group, however, identifies food supply as a considerable vulnerability, and in many similar communities in this UK region.

Despite the cultivated beauty of the town surroundings and the maintenance of the traditional town center infrastructure and architecture, the primary food and commercial enterprises are national chains. There are few locally owned businesses in the walkable town center that sell regionally sourced provisions. In addition, though there is resurgence in the use of community land devoted to family garden allotments, the land once used for supporting a market garden for the town is being converted into a parking lot.

In this example, Transition ideas confront the pastoral facade that a combination of policies and local institutions cultivate in many small English towns in the name of historical preservation, tourism, and other interests. Town zoning and policies align with this pastoral ideal is an agenda to maintain and to legislate a particular orientation towards the cultivation of natural settings. Several ecocritical theorists and historians outline the relationship between an aestheticization of landscapes, nature and wilderness and social and technological changes in those environments (Cronon 1996; Marx 1973; Merchant 1980). William Cronon (1996) describes the impact of the establishment of national parks in the development of public concepts of wilderness in America. Merchant (1980) illustrates how pastoral notions contribute to a particular conception of women's roles in

society, while Marx in his *Machine in the Garden* (1973) speculates on the ways that technologies and by association, modern industrial society, cleave through and disrupt natural landscapes in literature and art at the turn of the century. In the town described above, this pastoral aesthetic and the set of ordinances governing the management of the countryside and the maintenance of commercial and residential structures obscure local resource vulnerabilities that movement ideas call to public attention.

Having examined how founding members of the initiatives I visited articulated the ideas motivating their participation in TI, I now turn to look at a formal report created by one of the first UK groups outlining a plan for what this group calls “community energy descent”: community generated set of actions aimed at reducing community energy use. I suggest that the examination of practices used in TI that derive from identifying knowledge orders could aid in developing practices that amount to an *Emergent Technology Assessment* (ETA), or the possibility of new sociotechnical relationships beginning through a process of collective social change, rather than interventions that identify the risks and benefits of specific technologies or systems.

## **EMERGENT TECHNOLOGY ASSESSMENT**

This investigation into TI has explored how an ontology of interpretations of the relationships between natural and man made systems is received, digested and reinterpreted by a small group of citizens who in large part benefit from the current economic, social and political arrangements in their communities. I assert that these ideas are used to validate and frame conflicts in the Transition movement. These ideas are the

epistemic precondition for so-called “social technologies” employed by Transition groups to produce a systemic critique of the established sociotechnical order. TI members attempt to reimagine the way their communities have been constrained to think about the oil economy in mainstream culture and instead advocate for ideas and actions that emphasize resilient collective behaviors, localized resources and economic independence. This variation explains the wide appeal and rapid spread of the movement globally.

Variation in the uptake and emphasis of core TI ideas also raises questions about the nature of the solutions and activities these different understandings will spawn among TI groups across different geographies and national settings. TI leadership sees variation in the way the program is implemented in each new town as adaptive strength; however there may be hidden pitfalls. Emphasizing scarcity through the still not widely understood concept of peak oil will engender a set of actions that seek to mitigate a condition of limited resources. Motivating participation in local economic development by emphasizing localization without taking into account vulnerabilities that may arise from a changing climate will kick off a hunt for a different set of solutions. Confronting well established land and business management practices that mediate the rural landscape in northern UK and in turn attract international tourists to make arguments about local economic self-sufficiency may rile up stiff political opposition for the new movement. The point is that looking at knowledge orders in the TI movement provides an interesting case for following the linkages between variations in collective understandings of the relationship between sociotechnical systems and the environment and proposed practical actions towards building sustainable community. These knowledge orders play a

significant role in reorienting collective capacities towards a different sociotechnical arrangement.

### ***Community Energy Descent***

Energy Descent Action Plans (EDAPs) are an evolving ingredient of Transition. These are plans for decelerating energy use at the community level in fifteen to twenty years' time. Different from other peak oil plans and climate change planning documents being written internationally, the Transition EDAP is an artifact reflective of a community planning process that involves both the collection and assessment of regional data on indicators of concern (for example, local food supplies) as well as the results of backcasting (planning benchmarks with a future goal as the target), oral histories with community elders, and scenario planning. It is a locally crafted vision document for getting to a reduced level of energy use measured by a set of metrics that include both environmental data as well as citizen welfare. (Transition Culture" 2010; "Transition Culture" 2010; "Transition in Action, Totnes 2030, an Energy Descent Action Plan" 2010).

However Transition EDAPs do provide evidence of alternative methodologies for marshaling collective capacities with the intention of changing systemic relationships between human and technologies. At this early stage of development of the movement it remains to be seen whether alternative TI activities built upon differing understandings of the dynamics of society and nature can inspire significant and sustainable changes in socio-technical relationships.

## Chapter 5

### THE SOFT MEGAMACHINE

If this dissipation of Western Civilization is to cease, the first step in reconstruction is to make over our inner world, and to give our knowledge and our projections a new foundation (Mumford 1962, 268).

It is my aim not only to reinvigorate the critique of contemporary human/technology relationships that Mumford intended with his metaphor of the megamachine, but also to situate Mumford's critique relative to a heightened attention to the forces and conditions that manifest slow violence in today's society, referring to an invisible accretion of structural conditions that happen gradually over time and space. These conditions increase social and environmental harm that cannot be traced back to particular events or decisions. Mumford, Canetti and to some degree Latour wrote in the shadow of human-initiated destruction fueled by the increasing sophistication of military technology. Today, we give this human sociotechnical influence a new name: the anthropocene, referring to the evidence and extent of human activities that have had impact on global ecosystems. The anthropocene is another way of describing the megamachine, collective capacities of aggregate systems of regimented human beings, mechanized technologies and their environments, and the slow violence that the combination inflicts to produce what many believe are destabilizing environmental effects that will continue to escalate.

I cannot speak for the reader; I can only attest to my own reaction on this score. But when I absorbed in the full sense what the megamachine is there was a full stop. And then it was like the moment just after pressing the down arrow in the express elevator of a

skyscraper. It felt as if my family, my friends and lovers, people I can picture in my mind but will never meet playing out their routines both with joy and against adversity, and so many more with exponential dread, lowered into a sink. And there is a deep throb of dread for the world, its creatures and things.

If every crowd I have ever witnessed or read about in my life behaves as the megamachine, how can I possibly ever come to know another crowd form? Perhaps there are hints at these forms and ways of knowing that hint at a way to make a sociotechnical crowd that is not the megamachine. It is news: throngs of people concerned about labor, regime repression, and police brutality found one another through social media and birthed the Arab Spring. There too is the crowd of mostly teenagers and adults gathering in the streets of downtown Hong Kong, taking pictures of itself, its members writing notes about why it is there. Its thousand hands join those notes to an outer wall of the Hong Kong government's headquarters using language as bunting. Another crowd never touches, but instead from different rooms across time and space where keyboards click and the white light of screens forms iridescent spoons on the fronts of faces glinting in a billion eyes. The crowd seeks, and an analysis of the artifacts of those myriad keystrokes predict where and when the next flu pandemic will happen faster than medical professionals, though these capabilities are still under debate. These networks of people and things, what I call sociotechnical crowds, possess both creative and destructive capacities. The capacities of crowds have always existed, but mediating technologies bring them to our attention at a scale that has never been possible before. On the horizon, "convergent" technologies that combine the biological and engineering sciences may

further transform decision-making relationships between crowds, institutions, corporations and the state. New work must be done to understand the social, systemic, civic and democratic capacities of sociotechnical crowds.

I began Chapter Four by expressing my disappointment with Mumford's suggestion that individuals must withdraw from the knowledge, practice and material realities that perpetuate the megamachine. At the heart of this dissatisfaction lies a discomfort with what I perceive to be an ontological mismatch between how Mumford portrays the power of collective capacities that support creative and expansive journeying by men and women and the solution he proposes that depends (if uneasily) on individual agency as the catalyst for how society might break away. Langdon Winner's later proposal of Luddism as epistemology, as I have discussed, possesses the same problematic paradox. Though his prose that brings the megamachine into focus extends across many volumes, Mumford left the Earth without offering us a way out of the megamachine that gives sufficient attention to how supports for a sea change in the agency of collective capacities might be achieved.

One problem with finding a satisfying way forward has to do with a contested idea of what power is and what elements constitute it. There have been many skirmishes with the concept in this text already: the dubious possibility of individual agency in a regimented technological world, the domestication of commands in family, in daily routines, and through bureaucracy, the concept of elemental resistance of crowds and the non-human. The flip side of this largely negative scene is to consider a mode of power introduced by Joseph Nye in the 1990's called "soft power." Soft power describes the



charms of persuasion and attraction rather than coercion and associates these qualities with attributes of governments in the context of international relations, but operative in describing the reach of corporations, NGOs, transnational terrorist networks, and so on. Since Nye's first academic introduction of the term, indices have sprung up that attempt to measure soft power quantitatively. Calculating the influence among countries and other collectives is based on an accounting of their social, cultural and governance resources.

In a more recent discussion of the evolution and popularization of this concept, Nye reminds us that soft power is a descriptive rather than a normative concept (Nye 2011, 81). It can be cultivated and wielded for good or for ill. In a sense, the slow violence that I have been referring to all along here is a form of soft power exerted by the megamachine itself. However, in this final chapter I wish to use the idea of soft power to propose a way forward that takes the problem of changing the megamachine fully into account. I propose a soft megamachine, a loose framework that conceptualizes new supports, new social and political interventions, new research and exploration that could work to soften the rigidity of the megamachine and to allow creative mind to evolve some of the most entrenched morphology of its structure from within.

There are several areas where changes in research design, models of innovation, and public policies could together create conditions for wholly different sociotechnical interactions and take advantage of soft power variables to stimulate collective capacities towards normatively positive ends. I return to the five components of the megamachine: human parts, bureaucracy, organization of knowledge, power and transformation and

situate these components under three areas of practical concern: innovation, government to governance and emergence and convergence. Insights into collective capacities derived from my analysis of Mumford's megamachine, Canetti's crowds and Latour's actants, frame suggestions for both theoretical and practical ways forward in these three broad areas. Theoretical and practical conclusions captured in the "soft megamachine" framework open up the possibility for collective capacities to express themselves in ways other than to produce the megatechnics that Mumford critiques. My aim is to suggest new ways to design and conduct TA to include participatory processes framed as experiences for collective formation, or *bildung*. I conceptualize the soft megamachine and flesh it out in this final chapter as a means to apply this new understanding of new modes for sociotechnical crowds to new designs for incentivizing innovation, conceptualizing social emergence and convergence, and governance as an exercise of soft power.

## **INNOVATION**

In chapter two I showed how Mumford's megamachine is a critique of "innovation as progress", the dominant definition of innovation modern Westernized society and that is reflected in our science and technology policies. In Chapter Four, I show how a new global social movement is examining the outcomes of innovation as progress through the lens of fossil fuel addiction. The Transition Initiative uses what I call "social technologies" to change innovation priorities to include social values more centrally. From this bottom-up assessment example, I suggest a criteria that form the basis for *Emergent Technology Assessment* wherein TA organizers orient interventions around citizen agendas. I assert that this new model would not have to be institutionalized as the

Office of Technology Assessment in the US has been, but could be initiated by decentralized networks of heterogeneous organizations and stakeholders.

I also introduce the concept of pTA as *bildungsroman*, or an activity of civic formation that focuses on sociotechnical relationships. Framing pTA as *bildungsroman*, an experiential process of personal development in direct conversation with society and its technological systems, can reorient pTA towards the emergent qualities I have identified in Chapter Three. Researchers of pTA must be able to identify and distinguish between both the creative and also the destructive qualities of crowds in the process of transformation as I have revealed at length in Chapter Two. We must become better at articulating public values through processes like pTA.

*Bildung* is at the heart of STS ideals about the benefits of involving citizens in the evaluating scientific and technical futures. In this light, TA as a practice is an alternative way of conceptualizing innovation. This sort of innovation harnesses collective capacities to take advantage of creative energy that exists uniquely in the aggregate. The model of Emergent Technology Assessment I propose in the conclusion of Chapter Four is my contribution to technology policy based on this new concept of innovation.

A new technology policy that centers on collective human capacities rather than technological progress will require novel research methods for tracking this evolution. Mumford's emphasis on "human parts" as the decisive factor in innovation across history I translate here into a call for new science and technology studies research into how collective capacities translate into valued outcomes. Sustainability research moves analytic techniques some way down this path, but there is more to be done to account for

why changes to individual consumer behavior, for example motivating individuals to purchase goods with ecological packing, may still not add up to sustainable outcomes in the aggregate.

Changes in modes of analysis could address Mumford's critique of bureaucracy. A major difference between Mumford, Canetti and Latour pivots on the concept of aggregates in the irreductions appendix to *Pastuerization of France*. Actants cannot ever be seen as pawns moved about by a deeper organizational structure; each actant has its own negotiations to do and is irreducible to any other part. The paradox, however, is in the conception of systemic actants that have garnered meaning as a collective that itself has weight. For Mumford the megamachine is a powerful collective with particular characteristics that hold sway over the direction of creativity and have implications for both the psychological health of living things as well as for the material shape of things that come to being in the through that creativity. Canetti, in turn, through a radical turning away from the individual makes palpable the natural behavior of crowds as actants in the aggregate that are capable of many behaviors and caprice beyond those that drive the megamachine.

Conventional bureaucracy under the megamachine yields hierarchy, specialization, regimentation and positivist organization of knowledge. These particular aggregate structures set the conditions for the sort of innovation that is possible. In her study of states and social revolutions, Skocpol (1979) asserts that social revolutions are rapid and basic transformations of a society's state and class structures through analysis that validates its comparison across time and space based on similarities at the aggregate

unit of the state. Comparative analysis at the level of the nation state as an approach in political science has dominated social scientific analysis more broadly in the twenty first century. New methods of network analysis are beginning to become more prominent. This change in the importance of particular aggregate units of analysis in the social sciences is evolving along with the development of new data analytic techniques for characterizing the interaction of networks.

Research methods that assess collective capacities will move beyond using bureaucratic structures such as institutions, organizations, schools, or national states as units of meaning in social science analysis. Instead, new methods of network analysis born in data mining will reveal different ontologies of the collective. In Canetti's terms, different sort of crowds have different talents and knowledge.

## **EMERGENCE AND CONVERGENCE**

In Chapter Four I suggest that a look at practices used in TI that derive from identifying knowledge orders could aid in developing practices that amount to an *Emergent Technology Assessment (ETA)*. To test the theoretic framework in the first part of the dissertation about how collective capacities drive scientific and technical invention, I hypothesize that these particular epistemic arrangements lay the groundwork for a kind of *ETA*, or the ways in which collective social aspirations can drive sociotechnical innovation. I hypothesize that *ETA* will exhibit the following characteristics:

- The intervention is focused on change for societal supports and civic habits rather than specific technologies or issues.

- The intervention addresses or invokes embedded and socio-culturally situated processes to inform TA methodologies.
- The intervention depends upon performative person-to-person civic interactions
- The intervention has latent, but comprehensive and systemic implications for technological arrangements and implementation.

ETA as a concept illuminates the areas of formal pTA that might be improved upon by experimentation to include processes and approaches used by groups like TI attempting to motivate changes in social conventions rather than in particular technical regimes. This combination of formal and informal activities in society constitutes a deliberative system attentive to the “connections between instances, institutions, and spheres” that would necessarily work in concert to support the evolution of sociotechnical crowds away from the megamachine (Parkinson and Mansbridge 2012). Though my object is to reform TA into ETA, a general concern for agency in the context of various types of systems both the material kind and the social, political and economic is also implied.

A major question about emergence as a method for governing technological development, or any other sort of development, is whether different contingent solutions that are not tied to the convergent: standards, regulations, or zoning codes, and other legal parameters that have traditionally bounded the applications of technologies make for a society more oriented around creative mind? Does emergent policymaking reduce long-term sociotechnical risk more robustly than do convergent policymaking in the examples I mentioned? In the case of the Transition Initiative, its leadership sees variation in the way the program is implemented in each new town as adaptive strength; however there

may be hidden pitfalls that increase rather than mitigate future risks. Further research and scholarship should attend to this question of the relative value of emergence and convergence.

## **GOVERNMENT TO GOVERNANCE**

In Chapter Three, I outline a practice of technological wayfinding through experimental pTA in order to bring a variety of public values about technologies in cities into focus. I identified social, political, ethical and cultural values expressed by participants in the FCT pilot and mapped these value statements to select categories in Kevin Lynch's typology of imageability. In this way, have shown how materiality and experiential elements in the context of a dialog event can move contemporary pTA models beyond the "white men sitting at a table" model, colloquial shorthand for dialog by rational discourse. Dominant TA and pTA models rely too heavily on reasoned (and scientifically supported) discourse to take advantage of tacit knowledge.

pTA techniques that incorporate material and experiential elements enacts Mumford's idea of innovation as a function of human parts rather than of technologies. pTA processes attentive to tacit knowledge and affect can flag underlying public values that often go unarticulated. The pTA experiences I document here produce a quality of dialog that encourages collective formation, or *bildung*. These experiments also produce emergent thick descriptions of public values that are distinctly different than the data on public values that can be gathered with public opinion polls or focus groups. pTA of this kind fosters an iterative process wherein public values evolve in direct relation to probing

the material and experiential. Robust public value statements derived from pTA processes could form the basis for new design and development criteria for technologies based on social, legal and ethical concerns.

Elsewhere in this manuscript I describe how the development of technology assessment theory and practice as a case study in S&T governance is linked to a wider evolution of the public sphere. Technology assessment practices are one among many “social technologies” that are being prototyped, tested, remade, and discarded in this metamorphosis of the public sphere we are living through. These processes, among other things, can take advantage of both expert and local knowledge as a hybrid (Irwin 1995; Callon 2009). Mumford would link this trend to his speculation about the drivers of what he called the “biotechnic” age. What makes TA practices unique among social technologies is the degree to which TA enrolls the foundational sources of expertise primarily responsible for the dominant innovation culture: scientists, engineers, and other professionals.

## **CONCLUSION**

To sum up, in this concluding chapter I make suggestions for both theoretical and practical ways forward in three broad areas: Innovation, Emergence and Convergence, and Government to Governance. The theoretical and practical conclusions I draw and contextualize as a part of the “soft megamachine” framework open up the possibility for collective capacities to express themselves in ways other than through the regimented production of megatechnics. My goal has been to connect foundational STS theory about



sociotechnical formations to the practical applications of those ideas in TA. My research has led me to the conviction that reforming expert TA practices to more commonly include pTA attentive to materiality and affect is a critical contribution that STS scholars can advocate for at this moment.

There is lively debate in the STS community about experimental pTA forums and the roles of STS researchers as instigators of a number of these. Some complain that this new democratic governance for science and technology is merely a social experiment or at best market research (Laurent 2011; Mohr 2011). Others have argued that pTA conditions participants to accept a new technological reality through a process driven by scientific and technological power elites. In this view, pTA rationalizes central structural features of capitalist society while concealing its legitimation through participatory events (Bereano 1997; Kashefi 2006; Levidow 2007). A third stream of theorists question pTA's rationalist underpinnings (Mouffe 2000; Benhabib 2002).

These and other contestations signal that critical discussion beyond merely the organizational and institutional conditions for pTA is needed. Rather, vigorous debate over the means of pTA knowledge production, and the appropriate roles of STS scholars in it, are crucial for establishing its credibility and outreach. Recent projects such as the four-year European Union effort to enhance pTA's capacity and institutional foundation, Parliaments and Civil Society in Technology Assessment (PACITA) are invaluable venues for sustained consideration of the tensions between diverse logics of legitimacy at the science-policy interface.

As STS scholars get involved in the design, implementation and assessment of individual pTA interventions, their efforts become increasingly central to questions of the sustainability of the field more broadly. In doing so, they weigh the merits of establishing organizational and institutional havens where pTA can mature and weather political and economic change against more activist approaches, such as building networks outside academe that draw upon diverse resources, and rally broader audiences. Just as Irwin (2008) opened up the concept of science and technology policy to a richer notion of governance, I aspire to move past the idea that STS research interests in pTA are small-scale isolated experiments. Instead I aim to articulate a wider framing of pTA as a deliberative democratic system (Parkinson and Mansbridge 2012; Dryzek 2000) and point to how STS scholars can situate themselves in this landscape.

I want to close by invoking an idea from Lewis Mumford's first book on utopias (1962), first published in 1925. Mumford asserts that he would rather there be fewer utopias and more real living. As evidenced in the treatise on clocks and mechanization in Chapter Two, Mumford is critical of universals precisely because this unforgiving form predisposes our routines, aspirations, and technologies to behave rigidly based on an ideal rather than on a contingent set of relationships that make for a whole and rich life. As Redfield (1996) asserts in his account of the literary *bildungsroman*, an ideal state of formation in concert with one's environment can never be achieved fully. I choose to interpret *bildung's* unattainable ideal as a strength that places the emphasis on the contingent process of personal and social formation. To quote, then, from T.S. Eliot's (1959) poem "Four Quartets," in my end is my beginning.

## REFERENCES

- Árnason, Jóhann Páll. 2004. *Elias Canetti's Counter-Image of Society: Crowds, Power, Transformation*. Studies in German Literature, Linguistics, and Culture. Rochester, N.Y.: Camden House.
- Bacon, Francis. 1938. *The Advancement of Learning, and New Atlantis*. The World's Classics, XCIII. London: Oxford University Press.
- Bandelli, A., and E.A. Konijn. 2013. "Science Centers and Public Participation: Methods, Strategies, and Barriers." *Science Communication* 35(4): 419–48.
- Barben, Daniel. 2013. "Anticipatory Governance." in *Encyclopedia of Nanoscience and Society*, edited by Guston, David H. Thousand Oaks, Calif: Sage.
- Barben, D., E. Fisher, C. Selin, and D. Guston. 2008. "Anticipatory Governance of Nanotechnology: Foresight, Engagement, and Integration." In *The Handbook of Science and Technology Studies*, 979–1000.
- Barber, Benjamin R. 1984. *Strong Democracy: Participatory Politics for a New Age*. Berkeley: University of California Press.
- Quilley, Steve, and J Barry. 2008. "Transition Towns: 'Survival', 'Resilience' and Sustainable Communities: Outline of a Research Agenda." *Eco-Politics Online* 1(2): 12–31.
- . 2009. "The Transition to Sustainability: Transition Towns and Sustainable Communities." In Leonard, Liam, and John Barry. eds. 2009. *The Transition to Sustainable Living and Practice*. Emerald Group Publishing.
- Beck, Ulrich. 1992. *Risk Society: Towards a New Modernity*. London: Sage Publications.
- Benhabib, Seyla, ed. 1996. *Democracy and Difference: Contesting Boundaries of the Political*. Princeton Paperbacks. Princeton, N.J.: Princeton University Press, c1996.

- . 2002. *The Claims of Culture: Equality and Diversity in the Global Era*. Princeton, N.J: Princeton University Press.
- Bereano, P.L. 1997. “Reflections of a Participant-Observer: The Technocratic/democratic Contradiction in the Practice of Technology Assessment.” *Technological Forecasting and Social Change* 54 (2): 163–75.
- Bickerstaff, Karen, et al. 2010. “Locating Scientific Citizenship: The Institutional Contexts and Cultures of Public Engagement.” *Science, Technology & Human Values* 35 (4): 474–500.
- Bijker, Wiebe E. 1987. “The Social Construction of Bakelite: Toward a Theory of Invention.” In *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, edited by Wiebe E. Bijker, Thomas Parke Hughes, Trevor J. Pinch. Cambridge, Mass.: MIT Press, 155-182.
- Bimber, Bruce A. 1996. *The Politics of Expertise in Congress: The Rise and Fall of the Office of Technology Assessment*. Albany, NY: State University of New York Press.
- Bimber, Bruce, and David H. Guston. 1997. “Introduction: The End of OTA and the Future of Technology Assessment.” *Technological Forecasting and Social Change* 54 (2-3): 125–30.
- Blok, A. 2007. “Experts on Public Trial: On Democratizing Expertise Through a Danish Consensus Conference.” *Public Understanding of Science* 16 (2): 163.
- Blok, Anders. 2011. *Bruno Latour: Hybrid Thoughts in a Hybrid World*. Abingdon, Oxon; New York: Routledge.
- Bodewitz, Henk J.H.W., Henk Buurma, and Gerard de Vries. 1987. “Regulatory Science and the Social Management of Trust In Medicine.” In *The Social Construction of Technological Systems: New Directions in the Sociology and History of*

- Technology*, edited by Wiebe E. Bijker, Thomas Parke Hughes, and T. J. Pinch. Cambridge, Mass.: MIT Press, 237-252.
- Boes, Tobias. 2012. *Formative Fictions: Nationalism, Cosmopolitanism, and the Bildungsroman*. Signale: Modern German Letters, Cultures, and Thought. Ithaca, N.Y.: Cornell University Press: Cornell University Library.
- Bogner, Alexander. 2012. "The Paradox of Participation Experiments." *Science, Technology & Human Values* 37 (5): 506–27.
- Boucher, Stephen. 2009. "If Citizens Have a Voice, Who's Listening? Lessons from Recent Citizen Consultation Experiments for the European Union. CEPS EPIN Working Paper No. 24, 12 June 2009."
- Bowker, Geoffrey C., and Susan Leigh Star. 1999. "The Case of Race Classification Under Apartheid." In *Sorting Things out: Classification and Its Consequences*. Cambridge, Mass.; London: MIT Press.
- Bradbury, Ray. 1999. *Something Wicked This Way Comes*. 1st ed. New York: Avon Books.
- Brangwyn, Ben, and Rob Hopkins. 2008. *Transition Initiatives Primer: Becoming a Transition Town, City, District, Village, Community, or Even Island*. 26. <http://www.transitionnetwork.org/resources/transition-primer>.
- Brighenti, Andrea Mubi. 2010. "Tarde, Canetti, and Deleuze on Crowds and Packs." *Journal of Classical Sociology* 10 (4): 291–314.
- . 2011a. "Power, Subtraction and Social Transformation: Canetti and Foucault on the Notion of Resistance." *Distinktion: Scandinavian Journal of Social Theory* 12 (1): 57–78.
- . 2011b. "Elias Canetti and the Counter-Image of Resistance." *Thesis Eleven* 106 (1): 73–87.

- Brown, Mark B. 2009. *Science in Democracy: Expertise, Institutions, and Representation*. Cambridge, Mass.: MIT Press.
- Bull, R., J. Petts, and J. Evans. 2008. "Social Learning from Public Engagement: Dreaming the Impossible?" *Journal of Environmental Planning and Management* 51 (5): 701–16.
- Burgess, Michael M. 2014. "From 'Trust Us' to Participatory Governance: Deliberative Publics and Science Policy." *Public Understanding of Science* 23 (1): 48–52.
- Burroughs, William S. 1966. *The Soft Machine*. New York: Grove Press.
- Callon, Michel. 1986. "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St. Brieuc Bay." In *Power, Action, and Belief: A New Sociology of Knowledge?*, edited by John Law. Vol. 32. London; Boston: Routledge & Kegan Paul, 196-233.
- . 1987. "Society in the Making: The Study of Technology as a Tool for Sociological Analysis." In *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, edited by Wiebe E. Bijker, Thomas Parke Hughes, and T. J. Pinch. Cambridge, Mass.: MIT Press, 77-98.
- . 2009. *Acting in an Uncertain World an Essay on Technical Democracy*. Cambridge, Mass: MIT Press.
- Canetti, Elias. 1962. *Crowds and Power*. New York: Viking Press.
- Carpini, Michael X. Delli, Fay Lomax Cook, and Lawrence R. Jacobs. 2004. "Public Deliberation, Discursive Participation, and Citizen Engagement: A Review of the Empirical Literature." *Annual Review of Political Science* 7 (1): 315–44.
- Carson, Rachel. 1962. *Silent Spring*. Greenwich, Conn: Fawcett.

- Casillo, Robert. 1992. "Lewis Mumford and the Organicist Concept in Social Thought." *Journal of the History of Ideas* 53 (1): 91–116.
- Castells, Manuel. 2000. *The Rise of the Network Society*. 2nd ed. Information Age, v. 1. Oxford; Malden, Mass: Blackwell Publishers.
- Chevalier, Jacques M., and Daniel Buckles. 2012. *Participatory Action Research: Theory and Methods for Engaged*. Abingdon, Oxon; New York, NY: Routledge.
- Cobb, Michael, and Gretchen Gano. 2012. "Evaluating Structured Deliberations about Emerging Technologies: Post-Process Participant Evaluation." *International Journal of Emerging Technologies and Society* 10: 96–110.
- Collins, H.M., and R. Evans. 2002. "The Third Wave of Science Studies: Studies of Expertise and Experience." *Social Studies of Science* 32 (2): 235–96.
- Constant, Edward W. 1987. "The Social Locus of Technological Practice: Community, System, or Organization?" In *The Social Construction of Technological Systems : New Directions in the Sociology and History of Technology*, edited by Wiebe E. Bijker, Thomas Parke Hughes, and T. J. Pinch. Cambridge, Mass.: MIT Press, 217-236.
- Cowan, Ruth Schwartz. 1983. *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave*. New York: Basic Books.
- Cronon, W. 1996. "The Trouble with Wilderness: Or, Getting back to the Wrong Nature." *Environmental History* 1 (1): 7–28.
- Cussins, Charis Thompson. 1999. "Confessions of a Bioterrorist: Subject Position and Reproductive Technologies." In *Playing Dolly: Technocultural Formations, Fantasies, and Fictions of Assisted Reproduction*, edited by E. Ann Kaplan and Susan Merrill Squier. New Brunswick, N.J.; London: Rutgers University Press, 189-219.
- Dahl, Robert Alan. 1989. *Democracy and Its Critics*. New Haven: Yale University Press.

Davies, Sarah et al. 2009. "Discussing Dialogue: Perspectives on the Value of Science Dialogue Events That Do Not Inform Policy." *Public Understanding of Science*

Davies, Sarah R. et al. 2012. "Citizen Engagement and Urban Change: Three Case Studies of Material Deliberation." *Cities* 29 (6): 351–57.

———. 2013. "Finding Futures: A Spatio-Visual Experiment In Participatory Engagement." *Leonardo* 46 (1): 76–77.

Delborne, Jason A., A. A Anderson, D. L Kleinman, M. Colin, and M. Powell. 2011. "Virtual Deliberation? Prospects and Challenges for Integrating the Internet in Consensus Conferences." *Public Understanding of Science* 20 (3): 367–84.

Delborne, Jason A., Ashley A. Anderson, Daniel Lee Kleinman, Mathilde Colin, and Maria Powell. 2011. "Virtual Deliberation? Prospects and Challenges for Integrating the Internet in Consensus Conferences." *Public Understanding of Science*.

Deleuze, Gilles. 1987. *A Thousand Plateaus: Capitalism and Schizophrenia*. Minneapolis: University of Minnesota Press.

Deleuze, Gilles. 2001. *Deleuze and Guattari's Anti-Oedipus Introduction to Schizoanalysis*. London; New York: Routledge.

Dietz, T., and P. C. Stern, eds. 2009. *Public Participation in Environmental Assessment and Decision Making*. Washington, DC: National Academies Press.

Dryzek, John S. 2000. *Deliberative Democracy and Beyond: Liberals, Critics, Contestations*. Oxford; New York: Oxford University Press.

———. 2009. "Democratization as Deliberative Capacity Building." *Comparative Political Studies* 42 (11): 1379–1402.



———. 2010. *Foundations and Frontiers of Deliberative Governance*. Oxford; New York: Oxford University Press.

“Earth First! Worldwide.” 2010. <http://www.earthfirst.org/> (April 11, 2010).

Eliot, T. S. 1959. *Four Quartets*. Faber Paper Covered Editions. London: Faber and Faber.

Ellul, Jacques. 1964. *The Technological Society*. Vol.1 American. New York: Knopf.

Epstein, Steven. 1996. *Impure Science: AIDS, Activism, and the Politics of Knowledge*. Medicine and Society 7. Berkeley: University of California Press.

Escobar, Arturo. 2012. *Encountering Development: The Making and Unmaking of the Third World*. Princeton, N.J: Princeton University Press.

Ezrahi, Yaron. 1990. *The Descent of Icarus: Science and the Transformation of Contemporary Democracy*. Cambridge, Mass: Harvard University Press.

Farneti. 2006. “A Natural History of Crowds, Rulers and Survivors: Elias Canetti as a Political Thinker.” *History of Political Thought* 27 (4): 711–35.

Farrell, Katharine N. 2011. “Snow White and the Wicked Problems of the West: A Look at the Lines between Empirical Description and Normative Prescription.” *Science, Technology & Human Values* 36 (3): 334–61.

Ferguson, James. 1990. *The Anti-Politics Machine: “Development,” Depoliticization, and Bureaucratic Power in Lesotho*. Cambridge [England]; New York: Cambridge University Press.

Fischer, Frank. 2000. *Citizens, Experts, and the Environment: The Politics of Local Knowledge*. Durham, N.C.: Duke University Press.

- Fisher, E. 2005. "Lessons Learned from the Ethical, Legal and Social Implications Program (ELSI): Planning Societal Implications Research for the National Nanotechnology Program." *Technology in Society* 27 (3): 321–28.
- Foster, John Bellamy. 2000. *Marx's Ecology: Materialism and Nature*. New York: Monthly Review Press.
- Foucault, Michel, and Jay Miskowiec. 1986. "Of Other Spaces." *Diacritics* 16 (1): 22–27.
- Franklin, Sarah, and Helene Ragoné, eds. 1998. *Reproducing Reproduction: Kinship, Power, and Technological Innovation*. Philadelphia: University of Pennsylvania Press.
- Freud, Sigmund. 1922. *Group Psychology and the Analysis of the Ego / by Sigmund Freud; Authorized Translation by James Strachey*. New York: Boni and Liveright, [192-].
- Funtowicz, S. O, and J. R Ravetz. 1992. "Three Types of Risk Assessment and the Emergence of Post-Normal Science." *Social Theories of Risk* 273.
- Galtung, J. 1969. "Violence, Peace, and Peace Research." *Journal of Peace Research* 6 (3): 167–91.
- Geddes, Patrick. 1949. *Cities in Evolution*. New and rev. ed. London: Williams & Norgate.
- Gehrke, Pat J. 2014. "Ecological Validity and the Study of Publics: The Case for Organic Public Engagement Methods." *Public Understanding of Science* 23 (1): 77–91.
- Gibbons, Michael, ed. 1994. *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. London; Thousand Oaks, Calif: SAGE Publications.

- Glendinning, Chellis. 1990. "Notes toward a Neo-Luddite Manifesto." *Utne* (38): 50.
- Goodin, Robert E., and John S. Dryzek. 2006. "Deliberative Impacts: The Macro-Political Uptake of Mini-Publics." *Politics & Society* 34 (2): 219–44.
- Grin, John. 1997. *Technology Assessment through Interaction: A Guide*. Amsterdam: Rathenau Institute.
- Grin, John, and Henk van de Graaf. 1996. "Technology Assessment as Learning." *Science, Technology & Human Values* 21 (1): 72–99.
- Grunwald, Armin. 2013. "Technology Assessment." in *Encyclopedia of Nanoscience and Society*, edited by Guston, David H. Thousand Oaks, Calif: Sage.
- Gubrium, Aline, and Krista Harper. 2013. *Participatory Visual and Digital Methods*. Walnut Creek, California: Left Coast Press.
- Guston, David H. 2014. "Building the Capacity for Public Engagement with Science in the United States." *Public Understanding of Science* 23 (1): 53–59.
- . 2008. "Innovation Policy: Not Just a Jumbo Shrimp." *Nature* 454 (7207): 940–41.
- . 2000. *Between Politics and Science: Assuring the Integrity and Productivity of Research*. Cambridge, U.K: Cambridge University Press.
- . 1999. "Evaluating the First US Consensus Conference: The Impact of the Citizens' Panel on Telecommunications and the Future of Democracy." *Science, Technology & Human Values* 24 (4): 451.
- Guston, David H., and D. Sarewitz. 2002. "Real-Time Technology Assessment." *Technology in Society* 24 (1-2): 93–109.

- Habermas, Jürgen. 1989. *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society*. Studies in Contemporary German Social Thought. Cambridge, Mass: MIT Press.
- Hamlett, Patrick, Michael D. Cobb, and David H. Guston. 2013. "National Citizens' Technology Forum: Nanotechnologies and Human Enhancement." In *Nanotechnology, the Brain, and the Future*, 265–83. Springer.
- Hamlett, Patrick, Michael D. Cobb, and David H. Guston. 2013. "National Citizens' Technology Forum: Nanotechnologies and Human Enhancement." In *Nanotechnology, the Brain, and the Future*, Yearbook of Nanotechnology in Society, eds. Sean A. Hays, Jason Scott Robert, Clark A. Miller, and Ira Bennett. Springer Netherlands, 265–83.
- Hamlett, P. W. 2007. *The National Citizens' Technology Forum Handbook*. The Science, Technology & Society Program at North Carolina State University.
- Haraway, Donna Jeanne. 1991. *Simians, Cyborgs, and Women: The Reinvention of Nature*. London: Free Association Books.
- . 1997. *Modest-Witness@Second-Millennium. FemaleMan-Meets-OncoMouse: Feminism and Technoscience*. United States of America: Routledge.
- Harman, Graham. 2009. *Prince of Networks: Bruno Latour and Metaphysics*. Anamnesis. Prahran, Vic: Re.press.
- Harvey, David. 1996. *Justice, Nature and the Geography of Difference*. Cambridge, Mass: Blackwell Publishers.
- . 2000. *Spaces of Hope*. California Studies in Critical Human Geography 7. Berkeley: University of California Press.
- Hecht, Gabrielle. 1996. "Rebels and Pioneers: Technocratic Ideologies and Social Identities in the French Nuclear Workplace, 1955-69." *Social Studies of Science* 26 (3): 483–530.

- Heidegger, Martin. 1977. *The Question Concerning Technology, and Other Essays*. Harper Torchbooks.
- Hess, David J. 2007. *Alternative Pathways in Science and Industry: Activism, Innovation, and the Environment in an Era of Globalization*. Urban and Industrial Environments. Cambridge, Mass: MIT Press.
- Hess, David J. 2009. *Localist Movements in a Global Economy: Sustainability, Justice, and Urban Development in the United States*. Cambridge, Mass: MIT Press.
- Hobbes, Thomas. 2003. *Leviathan: A Critical Edition*. Bristol: Thoemmes Continuum.
- Holton, Gerald, and Gerhard Sonnert. 1999. "A Vision of Jeffersonian Science." *Issues in Science and Technology* (1).
- Honneth, Axel. 1996. "The Perpetuation of the State of Nature: On the Cognitive Content of Elias Canetti's Crowds and Power." *Thesis Eleven* 45 (1): 69–85.
- Horst. 2010. "Nations at Ease with Radical Knowledge: On Consensus, Consensusing and False Consensusness." *Social Studies of Science* 40 (1): 105.
- Horst, Maja, and Mike Michael. 2011. "On the Shoulders of Idiots: Re-Thinking Science Communication as 'Event.'" *Science as Culture* 20 (3): 283–306.
- Huebner, Bryce. 2014. *Macrocognition: A Theory of Distributed Minds and Collective Intentionality*. Oxford: Oxford University Press.
- Hughes. 1987. "The Evolution of Large Technological Systems." In *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, edited by Wiebe E. Bijker, Thomas Parke Hughes, and T. J. Pinch. Cambridge, Mass.: MIT Press, 45-76.
- Hughes, Thomas Parke. 1993. *Networks of Power: Electrification in Western Society, 1880-1930*. JHU Press.

- Hughes, Thomas Parke, and Agatha C. Hughes. 1990. "General Introduction: Mumford's Modern World." In *Lewis Mumford: Public Intellectual*, edited by Thomas P. Hughes and Agatha C Hughes. New York: Oxford University Press.
- Irwin, Alan. 1995. *Citizen Science: A Study of People, Expertise and Sustainable Development*. Environment and Society. London: Routledge.
- . 2008. "STS Perspectives on Scientific Governance." In *The Handbook of Science and Technology Studies*, edited by Edward J. Hackett, 3rd ed. Cambridge, Mass: MIT Press; Published in cooperation with the Society for the Social Studies of Science.
- . 2014. "From Deficit to Democracy (re-Visited)." *Public Understanding of Science* 23 (1): 71–76.
- Jamison, Andrew. 2001. *The Making of Green Knowledge: Environmental Politics and Cultural Transformation*. Cambridge: Cambridge University Press.
- Jasanoff, Sheila. 2003. "Technologies of Humility: Citizen Participation in Governing Science." *Minerva* 41 (3): 223–44.
- . 2004. "Science and Citizenship: A New Synergy." *Science and Public Policy* 31 (2): 90–94.
- . 2005. *Designs on Nature: Science and Democracy in Europe and the United States*. Princeton, N.J.: Princeton University Press.
- . 2006. *States of Knowledge: The Co-Production of Science and the Social Order*. London: Routledge.
- Jensen, Derrick. 2006. *Endgame*. Seven Stories Press 1st ed. New York: Seven Stories Press.

- Johnson, Deborah G. 2005. "Social Construction of Technology." In *Encyclopedia of Science, Technology, and Ethics*, edited by Carl Mitcham, 4:1791–95. Detroit: Macmillan Reference USA.
- Jones, Steven E. 2006. *Against Technology: From the Luddites to Neo-Luddism*. 1st edition. New York: Routledge.
- Juengst, Eric T. 1996. "Self-Critical Federal Science? The Ethics Experiment Within the U.S. Human Genome Project." *Social Philosophy and Policy* 13 (02): 63–95.
- Karnik, Niranjan. 2001. "Locating HIV/AIDS and India: Cautionary Notes on the Globalization of Categories." *Science, Technology & Human Values* 26 (3): 322–48.
- Kashefi, Elham. 2006. "Citizens' Juries: From Deliberation to Intervention." Lancaster University.
- Kelly, Susan E. 2003. "Public Bioethics and Publics: Consensus, Boundaries, and Participation in Biomedical Science Policy." *Science, Technology & Human Values* 28 (3): 339–64.
- Khagram, Sanjeev. 2004. *Dams and Development: Transnational Struggles for Water and Power*. Ithaca, NY: Cornell University Press.
- "Kinsale Energy Descent Action Plan. Transition Culture." 2010. Accessed June 23. <http://transitionculture.org/2005/11/24/kinsale-energy-descent-action-plan/>.
- Kitcher, Philip. 2001. *Science, Truth, and Democracy*. Oxford Studies in Philosophy of Science. Oxford; New York: Oxford University Press.
- Kurzweil, Ray. 2005. *The Singularity Is Near: When Humans Transcend Biology*. New York: Viking.

- Kvale, Steinar. 2008. *Doing Interviews*. SAGE.
- . 1996. *Interviews: An Introduction to Qualitative Research Interviewing*. Thousand Oaks, Calif: Sage Publications.
- Latour, Bruno. 2005. *Reassembling the Social: An Introduction to Actor-Network-Theory*. Clarendon Lectures in Management Studies. Oxford; New York: Oxford University Press.
- . 1988. *The Pasteurization of France*. Cambridge, Mass: Harvard University Press.
- . 1992. “Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts.” In *Shaping Technology / Building Society*, edited by Wiebe E. Bijker and John Law. Cambridge, Mass.: MIT Press, 225-258.
- . 1993. *We Have Never Been Modern*. Cambridge, Mass: Harvard University Press.
- . 1999. *Pandora’s Hope: Essays on the Reality of Science Studies*. Cambridge Mass.: Harvard University Press.
- Laurent, Brice. 2011. “Technologies of Democracy: Experiments and Demonstrations.” *Science and Engineering Ethics* 17 (4): 649.
- Law, John. 1987. “Technology and Heterogeneous Engineering: The Case of Portuguese Expansion.” In *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, edited by Wiebe E. Bijker, Thomas Parke Hughes, and T. J. Pinch. Cambridge, Mass.: MIT Press, 105-128.
- . Law, John. 1991. “Introduction: Monsters, Machines and Sociotechnical Relations.” *Sociological Review Monograph* 38(2): 1.



- Le Bon, Gustave. 1995. *The Crowd*. New Brunswick, N.J: Transaction Pub.
- Leigh Star, Susan. 1991. "Power, Technology and the Phenomenology of Conventions: Or Being Allergic to Onions." In *A Sociology of Monsters: Essays on Power, Technology, and Domination*. Vol. 38. London; New York: Routledge.
- Leiss, William. 1994. *The Domination of Nature*. Montreal: McGill-Queen's University Press.
- Lengwiler, Martin. 2008. "Participatory Approaches in Science and Technology." *Science, Technology & Human Values* 33 (2): 186–200.
- "Let's Talk About Food." <http://www.letstalkaboutfood.com/about-us/> (November 23, 2014).
- Levidow, Les. 2007. "European Public Participation as Risk Governance: Enhancing Democratic Accountability for Agbiotech Policy?" *East Asian Science, Technology and Society* 1 (1): 19–51.
- Leyda, Jay. 1960. *Kino: A History of the Russian and Soviet Film*. London: Allen & Unwin.
- Lindblom, Charles Edward. 1990. *Inquiry and Change: The Troubled Attempt to Understand and Shape Society*. New Haven, Conn. : Yale University Press.
- Lövbrand, Eva, Roger Pielke, and Silke Beck. 2011. "A Democracy Paradox in Studies of Science and Technology." *Science, Technology & Human Values* 36 (4): 474–96.
- Luks, F. 1999. "Post-Normal Science and the Rhetoric of Inquiry: Deconstructing Normal Science?" *Futures* 31 (7): 705–19.
- Lynch, Kevin. 1960. *The Image of the City*. MIT Press.

- MacKenzie, Donald A., and Judy Wajcman. 1999. *The Social Shaping of Technology*. Buckingham Eng.; Philadelphia: Open University Press.
- Malthus, T. R., Walter Layton, and Ernest Rhys. 1914. *An Essay on Population*. London: J. M. Dent & sons, ltd.; New York: E. P. Dutton & Co.
- Marker, Chris. 1997. *Le train en marche*. [S.l.]: [s.n.].
- Marris, Claire, Pierre-Benoit Joly, and Arie Rip. 2008. "Interactive Technology Assessment in the Real World Dual Dynamics in an iTA Exercise on Genetically Modified Vines." *Science, Technology & Human Values* 33 (1): 77–100.
- Marx, Leo. 1973. *The Machine in the Garden: Technology and the Pastoral Ideal in America*. New York: Oxford University Press.
- McClelland, John. 1996. "The Place of Elias Canetti's Crowds and Power in the History of Western Social and Political Thought." *Thesis Eleven* 45 (1): 16–27.
- McClelland, J. S. 1989. *The Crowd and the Mob: From Plato to Canetti*. London; Boston: Unwin Hyman.
- Melley, Timothy. 2002. "A Terminal Case: William Burroughs and the Logic of Addiction." In *High Anxieties Cultural Studies in Addiction*, edited by Janet Farrell Brodie and Marc Redfield. Berkeley: University of California Press, 38–59.
- Melucci, Alberto. 1996. *Challenging Codes: Collective Action in the Information Age*. Cambridge Cultural Social Studies. Cambridge: Cambridge University Press.
- Melville, Herman. 1930. *Pierre, Or, The Ambiguities*. Americana Deserta. New York: Alfred Knopf.
- Mendelberg, T. 2002. "The Deliberative Citizen: Theory and Evidence." *Political Decision Making, Deliberation and Participation* 6 (1): 151–93.

- Merchant, Carolyn. 1980. *The Death of Nature: Women, Ecology, and the Scientific Revolution*. 1st ed. San Francisco: Harper & Row.
- Merriman, John, and Jay Winter, eds. 2006. "Agitprop." In *Europe Since 1914: Encyclopedia of the Age of War and Reconstruction*, 1:19–20. Detroit: Charles Scribner's Sons.
- Miller, Clark A. 2004. "Climate Science and the Making of a Global Political Order." In *States of Knowledge: The Co-Production of Science and the Social Order*, edited by Sheila Jasanoff. Routledge, 46-65.
- Miller, Donald L. 1990. "The Myth of the Machine: I. Technics and Human Development." In *Lewis Mumford: Public Intellectual*, edited by Thomas Parke Hughes and Agatha C. Hughes. New York: Oxford University Press, 152–63.
- Mohr, Alison. 2011. "Publics in the Making: Mediating Different Methods of Engagement and the Publics These Construct." *Science and Engineering Ethics* 17 (4): 667.
- Moretti, Franco. 1987. *The Way of the World: The Bildungsroman in European Culture*. London: Verso.
- Morris, William. 1890. *News from Nowhere; Or, An Epoch of Rest. Being Some Chapters from a Utopian Romance*. Boston: Roberts Brothers.
- Mouffe, Chantal. 2000. *The Democratic Paradox*. New York: Verso.
- Mumford, Lewis. 1929. *Herman Melville*. New York: Harcourt, Brace.
- . 1955. *The Brown Decades; a Study of the Arts in America, 1865-1895*. 2d rev. ed. New York: Dover Publications.
- . 1961a. *The City in History: Its Origins, Its Transformations, Andits Prospects*. 1st ed. New York: Harcourt, Brace & World.

- . 1961b. “History: Neglected Clue to Technological Change.” *Technology & Culture* 2 (3): 230–36.
- . 1962. *The Story of Utopias*. New York: Viking Press.
- . 1963. *Technics and Civilization*. 1st Harbinger Books ed. New York: Harcourt Brace Jovanovich.
- . 1966a. “Technics and the Nature of Man.” *Technology and Culture* 7 (3): 303–17.
- . 1966b. “The First Megamachine.” *Diogenes* 14 (55): 1–15.
- . 1967. *The Myth of the Machine: 1. Technics and Human Development*. 1st ed. New York: Harcourt, Brace & World.
- . 1970. *The Myth of the Machine: 2. Pentagon of Power*. 1st ed. New York: Harcourt, Brace & World.
- . 1968. *The Urban Prospect; [Essays]*. 1st ed.]. New York: Harcourt, Brace & World.
- . 1963. *Technics and Civilization*. 1st Harbinger Books ed. New York: Harcourt Brace Jovanovich.
- National Academy of Sciences (U.S.). 1969. *Technology: Processes of Assessment and Choice Report of the National Academy of Sciences*. [Washington: For sale by the Supt. of Docs. U.S. Govt. Print. Off.].
- National Academy of Sciences (U.S.), Panel on Technology Assessment, United States National Academy of Sciences (U.S.), Congress, House, and Committee on Science and Astronautics. 1969. *Technology: Processes of Assessment and*

- Choice; Report of the National Academy of Sciences*. [Washington]: [For sale by the Supt. of Docs., U.S. Govt. Print. Off.].
- Nixon, Rob. 2011. *Slow Violence and the Environmentalism of the Poor*. Cambridge, Mass: Harvard University Press.
- Nordmann, A., and A. Schwarz. 2010. "Lure of the 'Yes': The Seductive Power of Technoscience." *Governing Future Technologies*, 255–77.
- Nussbaum, Martha Craven. 2000. *Women and Human Development: The Capabilities Approach*. The John Robert Seeley Lectures. Cambridge, U.K.; New York: Cambridge University Press.
- Nye, David E. 1994. *American Technological Sublime*. Cambridge, Mass: MIT Press.
- Oudshoorn, Nelly, and T. J Pinch, eds. 2003. *How Users Matter: The Co-Construction of Users and Technologies*. Inside Technology. Cambridge, Mass: MIT Press.
- Parigi, Paolo. 2012. "Stanford Transition US Social Network Survey - Transition in Action Social Network." <http://transitioninaction.com/forum/topics/stanford-transition-us-social>. (May 9, 2012).
- Parkinson, John. 2012. *Democracy and Public Space: The Physical Sites of Democratic Performance*. Oxford; New York: Oxford University Press.
- Parkinson, John, and Jane J. Mansbridge, eds. 2012. *Deliberative Systems: Deliberative Democracy at the Large Scale*. Theories of Institutional Design. Cambridge: Cambridge University Press.
- Passini, Romedi. 1984. *Wayfinding in Architecture*. Environmental Design Series, v. 4. New York: Van Nostrand Reinhold.
- Perrow, Charles. 1984. *Normal Accidents: Living with High-Risk Technologies*. New York: Basic Books.

- Philbrick, Mark, and Javiera Barandiaran. 2009. "The National Citizens' Technology Forum: Lessons for the Future." *Science and Public Policy* 36 (5): 335–47.
- Pinch, T.J., and Wiebe E. Bijker. 1987. "The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other." In *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, edited by Wiebe E. Bijker, Thomas Parke Hughes, Trevor J. Pinch. Cambridge, Mass.: MIT Press, 11-44.
- Pink, Sarah. 2008. "An Urban Tour The Sensory Sociality of Ethnographic Place-Making." *Ethnography* 9 (2): 175–96.
- . 2011. "Amateur Photographic Practice, Collective Representation and the Constitution of Place." *Visual Studies* 26 (2): 92–101.
- Powell, Maria, Jason Delborne, and Mathilde Colin. 2011. "Beyond Engagement Exercises: Exploring the US National Citizens' Technology Forum from the Bottom-Up." *Journal of Public Deliberation* 7 (1): 4.
- Rajan, Kaushik Sunder. 2006. *Biocapital: The Constitution of Postgenomic Life*. Duke University Press Books.
- Redfield, Marc. 1996. *Phantom Formations: Aesthetic Ideology and the Bildungsroman*. Ithaca, N.Y: Cornell University Press.
- . *The Bildungsroman*. N.d. Oxford University Press.  
<http://www.oxfordreference.com/10.1093/acref/9780195169218.001.0001/acref-9780195169218-e-0043>.
- Rip, Arie, Thomas J. Misa, and Johan Schot, eds. 1995. *Managing Technology in Society: The Approach of Constructive Technology Assessment*. London; New York: New York: Pinter Publishers; Distributed in the United States by St. Martin's Press.

- Rochberg-Halton, Eugene. 1986. *Meaning and Modernity: Social Theory in the Pragmatic Attitude / Eugene Rochberg-Halton*. Chicago: University of Chicago Press, 1986.
- . 1990. “The Transformation of Social Theory.” In *Lewis Mumford: Public Intellectual*, edited by Agatha C Hughes and Thomas Parke Hughes. Oxford University Press, 127-151.
- Sale, Kirkpatrick. 1995. *Rebels Against the Future: The Luddites and Their War On the Industrial Revolution: Lessons for the Computer Age*. Reading, Mass: Addison-Wesley Pub. Co.
- Sanders, Lynn M. 1997. “Against Deliberation.” *Political Theory* 25 (3): 347–76.
- Schaffer, Simon. 1991. “The Pasteurization of France: Bruno Latour, Translated by Alan Sheridan and John Law (Cambridge, Massachusetts and London: Harvard University Press, 1988), 273 Pp. ISBN 0-674-65760-8 Cloth £23.95.” *Studies in History and Philosophy of Science Part A* 22 (1): 174–92.
- Schellinger, Paul, Christopher Hudson, and Marijke Rijsberman. 1998. “Bildungsroman.” *Encyclopedia of the Novel*. Chicago: London: Fitzroy Dearborn Publishers.
- Schnittke, Alfred, Chris Marker, Michael Kustow, Michael Pennington, and Alexander Medvedkin. 1993. *The Last Bolshevik Le tombeau d’Alexandre*. London: Connoisseur/Academy Video.
- Schwartz Cowan, Ruth. 1987. “The Consumption Junction: A Proposal for Research Strategies in the Sociology of Technology.” In *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, edited by Wiebe E. Bijker, Thomas Parke Hughes, Trevor J. Pinch. Cambridge, Mass.: MIT Press, 253-272.
- Sclove, R. E. 2010. “Reinventing Technology Assessment for the 21st Century.” [http://www.wilsoncenter.org/index.cfm?fuseaction=news.item&news\\_id=611665](http://www.wilsoncenter.org/index.cfm?fuseaction=news.item&news_id=611665). (May 8, 2010).

- Sclove, Richard. 1995. *Democracy and Technology*. New York: Guilford Press.
- Seifert, Franz, and Alexandra Plows. 2014. "From Anti-Biotech to Nano-Watch: Early Risers and Spin-Off Campaigners in Germany, the UK and Internationally." *NanoEthics* 8 (1): 73–89.
- Selin, C. 2008a. *The Future of Medical Diagnostics. Scenario Development Workshop Report*. CNS-ASU Report #R08-0001. Tempe, AZ. Tempe, AZ.: Center for Nanotechnology in Society at Arizona State University.
- . 2008b. "The Sociology of the Future: Tracing Stories of Technology and Time." *Sociology Compass* 2 (6): 1878–95.
- Selin, C., and R. Hudson. 2010. "Envisioning Nanotechnology: New Media and Future-Oriented Stakeholder Dialogue." *Technology in Society* 32 (3): 173–82.
- Selin, Cynthia et al. (forthcoming) "Experiments in Engagement: Designing PEST for Capacity-Building." *Public Understanding of Science*.
- Sen, Suvarna, ed. 2006. *Gender and Development*. 1st ed. ICFAI Books. Hyderabad, India: ICFAI University Press.
- Sey Seyfang, Gill, and Noel Longhurst. 2013. "Desperately Seeking Niches: Grassroots Innovations and Niche Development in the Community Currency Field." *Global Environmental Change* (5): 881.
- Shakespeare, William. 1893. *Macbeth: With an Introduction and Notes*. Macmillan.
- Shane, David Grahame. 2005. *Recombinant Urbanism : Conceptual Modeling in Architecture, Urban Design, and City Theory / David Grahame Shane*. Chichester, England; Hoboken, NJ: Wiley, 2005.



- Shapin, Steven, Simon Schaffer, and Thomas Hobbes. 1985. *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life: Including a Translation of Thomas Hobbes, Dialogus Physicus de Natura Aeris by Simon Schaffer*. Princeton, N.J.: Princeton University Press.
- Skocpol, Theda. 1979. *States and Social Revolutions: A Comparative Analysis of France, Russia, and China*. Cambridge; New York: Cambridge University Press.
- Smith, Adam. 1904. *An Inquiry Into the Nature and Causes of the Wealth of Nations*. New York: G.P. Putnam's Sons.
- Smith, Merritt Roe, and Leo Marx, eds. 1994. *Does Technology Drive History?* Cambridge, Mass.: MIT Press.
- Smith, Merritt Row. 1994. "Technological Determinism in American Culture." In *Does Technology Drive History?*, edited by Merritt Roe Smith and Leo Marx. Cambridge, Mass.: MIT Press, 1-36.
- Smith, Neil. 1984. *Uneven Development: Nature, Capital, and the Production of Space*. Oxford (Oxfordshire): B. Blackwell.
- Sorensen, E. 2006. "Metagovernance: The Changing Role of Politicians in Processes of Democratic Governance." *The American Review of Public Administration* 36 (1): 98–114.
- Stark, Trevor. 2012. "'Cinema in the Hands of the People': Chris Marker, the Medvedkin Group, and the Potential of Militant Film." *October*, no. 139 (Winter): 117–50.
- Tarde, Gabriel de. 1901. *L'opinion et La Foule*. Paris: F. Alcan.
- "The Center for Nanotechnology in Society at Arizona State University Overview." 2014. Arizona State University. [cns.asu.edu/sites/default/files/cns\\_flier\\_feb2014.pdf](http://cns.asu.edu/sites/default/files/cns_flier_feb2014.pdf). (March 3, 2014).

- Thompson, Charis. 2005. *Making Parents: The Ontological Choreography of Reproductive Technologies*. Cambridge, Mass.: MIT Press.
- “Transition in Action, Totnes 2030, an Energy Descent Action Plan.” 2010. Accessed June 30. <http://totnesdap.org.uk/>. (August 5, 2010).
- Traulsen, Janine Morgall. 1993. *Technology Assessment: A Feminist Perspective*. Labor and Social Change. Philadelphia: Temple University Press.
- “U.S. GAO - Technology Assessment: Climate Engineering: Technical Status, Future Directions, and Potential Responses.” 2011. <http://www.gao.gov/products/GAO-11-71>. (November 8, 2011).
- Van den Belt, Henk, and Arie Rip. 1987. “The Nelson-Winter-Dosi Model and Synthetic Dye Chemistry.” In *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, edited by Wiebe E. Bijker, Thomas Parke Hughes, and T. J. Pinch. Cambridge, Mass.: MIT Press, 129-154.
- Wajcman, Judy. 1991. *Feminism Confronts Technology*. Cambridge, UK: Polity Press.
- Wang, Caroline, and Mary Ann Burris. 1994. “Empowerment through Photo Novella: Portraits of Participation.” *Health Education & Behavior* 21 (2): 171–86.
- . 1997. “Photovoice: Concept, Methodology, and Use for Participatory Needs Assessment.” *Health Education & Behavior* 24 (3): 369–87.
- Wehling, Peter. 2012. “From Invited to Uninvited Participation (and Back?): Rethinking Civil Society Engagement in Technology Assessment and Development.” *Poiesis & Praxis* 9 (1-2): 43–60.
- White, Lynn Townsend. 1962. *Medieval Technology and Social Change*. Oxford: Clarendon Press.

- Wickson, F., M. D. Cobb, and P. Hamlett. 2011. "Review of Deliberative Processes: National Citizens Technology Forum—USA." *Democratisation of Science and Technology Development: Deliberative Processes in the Development of Nanotechnologies*. Pan Stanford Publishing, Singapore.
- Wickson, Fern, Ana Delgado, and Kamilla Lein Kjolberg. 2010. "Who or What Is 'the Public'?" *Nat Nano* 5 (11): 757–58.
- Winner, Langdon. 1978. *Autonomous Technology: Technics-Out-of-Control as a Theme in Political Thought*. Cambridge, Mass.: MIT Press.
- . 1986. *The Whale and the Reactor: A Search for Limits in an Age of High Technology*. Chicago: University of Chicago Press.
- Wolin, Sheldon S. 1969. "Political Theory as a Vocation." *The American Political Science Review* 63 (4): 1062–82.
- Woolgar, Steve, and Javier Lezaun. 2013. "The Wrong Bin Bag: A Turn to Ontology in Science and Technology Studies?" *Social Studies of Science* 43 (3): 321–40.
- Worthington, Richard, et al. 2012. *Technology Assessment and Public Participation: From TA to pTA*. Expert and Citizen Assessment of Science and Technology (ECAST). Woodrow Wilson International Center for Scholars Science, Technology Innovation Program Report.
- Wyatt, Sally. 2013. "Technological Determinism Is Dead; Long Live Technological Determinism." In *Philosophy of Technology: The Technological Condition: An Anthology*. Edited by Scharff, Robert C., and Val Dusek. Hoboken: Wiley, 456–466.
- Wynne, Bryan 1975. "The Rhetoric of Consensus Politics: A Critical Review of Technology Assessment." *Research Policy* 4 (2): 108–58.

- . 1996. “May the Sheep Safely Graze? A Reflexive View of the Expert-Lay Knowledge Divide.” *Risk, Environment and Modernity: Towards a New Ecology*, 44–83.
- . 2006a. “Public Engagement as a Means of Restoring Public Trust in Science - Hitting the Notes, but Missing the Music?” *Community Genetics* 9 (3): 211–20.
- . 2014. “Further Disorientation in the Hall of Mirrors.” *Public Understanding of Science* 23 (1): 60–70.
- Young, Iris Marion. 2000. *Inclusion and Democracy*. Oxford Political Theory. Oxford; New York: Oxford University Press.
- Zimmerman, Marc A., and Julian Rappaport. 1988. “Citizen Participation, Perceived Control, and Psychological Empowerment.” *American Journal of Community Psychology* 16 (5): 725–50.

APPENDIX A

INTERVIEW PROTOCOL:

PARTICIPATORY TECHNOLOGY ASSESSMENT AT THE ENDLESS TABLE

## **About the PES design (for organizers)**

### **Descriptive**

1) Describe the endless table project.

What guided your choices about the design of this event?

3) What specific outcomes would you like to see?

### **Tools, information/knowledge, experts**

4) What kinds of "tools/props" are used to facilitate those dialogues?

5) Who is involved? What are the participants' specific roles?

6) What knowledge is represented/supported in this exercise?

How much/what kind of scientific evidence or background is presented?

### **Outcomes**

7) How did this use of tools/experts/facilitators play out during the conversations?

Did people relate to them?

8) What challenges did you encounter? What would you change?

9) How would you describe the desired outcomes?

If there are results or recommendations that emerge from the conversations, what do you expect to do with them?

In which format are they then passed on to relevant "ears"?

## **About PES experience (for participants / facilitators / experts)**

### **Descriptive**

- 1) Describe what is happening here today at these discussions
- 2) How did you feel about taking part in the discussion?

### **Tools, information/knowledge, experts**

- 3) Thinking about the way this event was organized,
  - a. What attracted you to this particular topic of conversation? Were there other topics you would have liked to talk about?
  - b. What got the conversation going? What was the most interesting to talk about? The most difficult?
  - c. What did your group ask the expert? Was this helpful? (a placeholder, will be asked in context of discussion)
  - d. Did you refer to information on the menu?
- 4) What did you contribute to the discussion? What did you learn from others?

### **Outcomes**

- 5) What did you/your group decide/recommend?
- 6) Would you come to another one of these events? What did you like most/least?

APPENDIX B

INTERVIEW PROTOCOL: LOCAL DELIBERATION [TRIGGERED BY]  
IMAGINED TRANSITION EPSTEMOLOGIES. A STUDY OF THE US AND UK  
TRANSITION INITIATIVES



Themes	Example Questions
<p>Triggers / frames</p> <p><b><u>The Luddist move</u></b></p> <p>Covering personal motivations and details of group development in the town</p> <p>Awareness raising activities and</p> <p>Media and materials</p>	<p>*Do you know the details of how your town became involved with the Transition Initiative?</p> <p>*How did you get involved with the Transition Initiative personally?</p> <p>(Prompts for personal, social, norms, practical, etc. facets)</p> <p>*Were there activities you participated in that helped get you interested?</p> <p>*What media or materials did you become exposed to in the Transition Initiative?</p> <p>*What did you think of them? Did any of these change your mind/perspective?</p>
<p>Measures of</p> <p><b><u>System autonomy</u></b></p> <p>Pre-existing routines and knowledge</p>	<p>*What does a typical day look like here?</p> <p>*Which routines do you/your family/your community engage in that you now consider unsustainable since you have been involved in the Transition Initiative?</p> <p>*What do you do you know about how these systems work?</p> <p>*Where would you get information about them?</p>
<p>Forms of life/Megamachine</p>	<p>*Describe your family/friends/social setting... (Open ended prompts, etc.)</p> <p>*How would you describe your personal values/beliefs/the values of your community? How do these relate to Transition Town work?</p> <p>* Hopes/fears for future states...</p>
<p>Technological systems</p>	<p>*Thinking about TTI work, which systems does it touch?</p> <p>*How do you think these systems might be impacted by Transition Town planning?</p>

APPENDIX C

INSTITUTIONAL REVIEW BOARD APPROVAL DOCUMENTATION

**To:** Cynthia Selin  
CSPO/ASU

**From:** Mark Roosa, Chair  
Soc Beh IRB

**Date:** 10/01/2012

**Committee Action:** **Exemption Granted**

**IRB Action Date:** 10/01/2012

**IRB Protocol #:** 1209008287

**Study Title:** Futurescape City Tours

The above-referenced protocol is considered exempt after review by the Institutional Review Board pursuant to Federal regulations, 45 CFR Part 46.101(b)(2) .

This part of the federal regulations requires that the information be recorded by investigators in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects. It is necessary that the information obtained not be such that if disclosed outside the research, it could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

You should retain a copy of this letter for your records.

**From:** Tiffany Dunning  
**Sent:** Thursday, June 23, 2011 3:57 PM  
**To:** David Guston; Gretchen Gano  
**Subject:** Participatory Technology Assessment at the Endless Table

Dear David Guston and Gretchen Gano,

Your study "Participatory Technology Assessment at the Endless Table" has been considered exempt after review by the Institutional Review Board pursuant to Federal regulations, 45 CFR Part 46.101(b)(2). Attached to this email please find a copy of your approval letter. Research may begin.

Thank you, Tiffany

Tiffany Dunning IRB Coordinator  
Office of Research Integrity and Assurance Center Point, 660 S. Mill  
Avenue Suite 315 Arizona State University Tempe, AZ 85287-6111 (Mail  
Code 6111) Telephone: 480 965-6788

Fax: 480 965-7772 <http://researchintegrity.asu.edu/humans>



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Office of Research Integrity and Assurance

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**To:** David Guston  
Interdisci

*for* **From:** Mark Roosa, Chair *SM*  
Soc Beh IRB

**Date:** 06/01/2010

**Committee Action:** Exemption Granted

**IRB Action Date:** 06/01/2010

**IRB Protocol #:** 1005005176

**Study Title:** Local Deliberation [triggered by] Imagined Transition Epistemologies:

A Study of US and UK Transition Initiatives

The above-referenced protocol is considered exempt after review by the Institutional Review Board pursuant to Federal regulations, 45 CFR Part 46.101(b)(2).

This part of the federal regulations requires that the information be recorded by investigators in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects. It is necessary that the information obtained not be such that if disclosed outside the research, it could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

You should retain a copy of this letter for your records.

APPENDIX D

ARCHITECTURAL THEORY SINCE 1968: SELECT REFERENCES

Alexander, Christopher. 1987. *A New Theory of Urban Design / Christopher Alexander ... [et Al.]*. New York: Oxford University Press, 1987.

Asquith, Lindsay, and Marcel Vellinga, eds. 2006. *Vernacular Architecture in the Twenty-First Century: Theory, Education and Practice*. London□; New York: Taylor & Francis.

Berman, Marshall. 1982. *All That Is Solid Melts into Air: The Experience of Modernity*. New York: Simon and Schuster.

Bibliothèque, nationale de France, and York Public Library New. 2000. *Utopia: The Search for the Ideal Society in the Western World*. New York: New York Public Library/Oxford University Press.

Bokina, John, and Timothy J. Lukes, eds. 1994. *Marcuse: From the New Left to the next Left*. Lawrence, Kan: University Press of Kansas.

Certeau, Michel de. 1984. *The Practice of Everyday Life*. Berkeley: University of California Press.

De La Salle, Janine M., and Mark Holland. 2010. *Agricultural Urbanism: Handbook for Building Sustainable Food & Agriculture Systems in 21st Century Cities / Janine de La Salle & Mark Holland [eds.] with Contributors*. 1st ed.

Duany, Andres. 2011. *Garden Cities: Theory & Practice of Agrarian Urbanism / [Andres Duany & DPZ]*. [U.K..]: Duany Plater Zybrec & Co.: The Prince's Foundation for the Built Environment, 2011.

Feenberg, A. "The Critique of Technology: From Dystopia to Interaction." *Marcuse: From the New Left to the Next Left*: 208–26.

Foucault, Michel, and Jay Miskowiec. 1986. "Of Other Spaces." *Diacritics* 16(1): 22–27.

- Fuller, R. Buckminster, and Museum of American Art Whitney. 2008. *Buckminster Fuller: Starting with the Universe*. New York: Whitney Museum of American Art, in association with Yale University Press.
- Giedion, S. 1948. *Mechanization Takes Command, a Contribution to Anonymous History*. New York: Oxford University Press.
- Harris, Steven, and Deborah Berke. 1997. *Architecture of the Everyday*, edited by Steven Harris and Deborah Berke. 1st ed.
- Hensel, Michael, Achim Menges, and Michael Weinstock. 2010. *Emergent Technologies and Design / Michael Hensel, Achim Menges and Michael Weinstock*. Oxon, [U.K.]; New York, NY: Routledge.
- Johnstone, Stephen, ed. 2008. *The Everyday*. London: Cambridge, Mass: Whitechapel; MIT Press.
- Lefebvre, Henri. 1991. *The Production of Space*. Oxford, OX, UK: Blackwell.  
 ———. 2003. *The Urban Revolution*. Minneapolis: University of Minnesota Press.
- Leach, Neil, ed. 1997. *Rethinking Architecture: A Reader in Cultural Theory*. London: Routledge.
- Lukes, Timothy J. 1985. *The Flight into Inwardness: An Exposition and Critique of Herbert Marcuse's Theory of Liberative Aesthetics*. Selinsgrove [Pa.]: Susquehanna University Press.
- Mallgrave, Harry Francis. 2005. *Modern Architectural Theory: A Historical Survey, 1673-1968*. Cambridge: Cambridge University Press.
- Marcuse, Herbert. 1964. *One Dimensional Man; Studies in the Ideology of Advanced Industrial Society*. Boston: Beacon Press.



- McHarg, Ian L, and Museum of Natural History American. 1969. *Design with Nature*. 1st ed. Garden City, N.Y: Published for the American Museum of Natural History [by] the Natural History Press.
- Mehaffy, Michael W. 2008. "Generative Methods in Urban Design: A Progress Assessment." *Journal of Urbanism* 1(1): 57.
- Mirzoeff, Nicholas, ed. 1998. *The Visual Culture Reader*. London; New York: Routledge.
- Nye, David E, and College Amherst. 2003. *America as Second Creation: Technology and Narratives of New Beginnings*. Cambridge, Mass: MIT Press.
- Portola, Institute. *Whole Earth Catalog*. Menlo Park, Calif: Portola Institute.
- Siebers, Tobin, ed. 1994. *Heterotopia: Postmodern Utopia and the Body Politic*. Ann Arbor: University of Michigan Press.
- Umbach, Maiken, and Bernd-Rüdiger Hüppauf, eds. 2005. *Vernacular Modernism: Heimat, Globalization, and the Built Environment*. Stanford, Calif: Stanford University Press.
- Wigley, Mark. 2001. "Network Fever." *Grey Room* -: 82–122.  
<http://dx.doi.org/10.1162/152638101750420825> (November 24, 2014).

## BIOGRAPHICAL SKETCH

Gretchen Gano received her Ph.D. at Arizona State University in the Human & Social Dimensions of Science and Technology. Gano holds Masters Degrees in Science and Technology Policy and Library and Information Science from Rutgers University. Gano is active in the Expert and Citizen Assessment of Science and Technology (ECAST) Network. ECAST is a national network of nonpartisan policy research institutions, universities, and informal science education centers working together to conduct balanced technology assessments. Its mission is to support better-informed governmental and societal decisions on complex issues involving science and technology.