

Field Theory and Technology: Notes Toward a Conversation

**Lee Jared Vinsel
Stevens Institute of Technology**

WORKING PAPER

Please Do Not Cite without Permission

In recent years, sociology and other academic disciplines have shown considerable interest in field theory as a general explanatory framework for collective social action. These developments draw on work by earlier scholars on fields, especially the work of Pierre Bourdieu. Two recent expressions of the renewed interest in field theory in sociology are John Levi Martin's *The Explanation of Social Action* (2011) and Neil Fligstein and Doug McAdam's *A Theory of Fields* (2012), the latter of which built on a summary article published a year earlier in these pages (Fligstein and McAdam 2011). In Fligstein and McAdam's account of the rediscovery of field theory, sociologists working separately in social movement studies and organizational studies found that they were looking at objects with similar shapes and dynamics. This similarity suggests an underlying common structure to collective social action, which they argue holds for such disparate things as "organizations, extended families, clans, supply chains, social movements, and governmental systems." (Fligstein and McAdam 2011, 3) Field theory attempts to offer a parsimonious, yet robust, description of this structure.

Technologies often play a central role in the shape, contours, and topography of social fields, but, thus far, field theorists have not taken any thorough account of technological change or how actors take up technologies. Indeed, when field theorists mention technologies they usually do so in glancing ways. For instance, Fligstein and McAdam write, "Our modern conceptions of time and space have been greatly altered by improvements in technology, communications, and transportation that have increased our ability to be aware of and even control distant events." (2012, 61) Fair enough, but technologies also play many more subtle, complicated, and multifaceted roles. In this essay, I attempt to bring field theory together with several traditions of technology studies. My case here is not simply a kind of +1 argument that sociologists should also consider technologies in addition to the other things they study. Technologies directly impinge on issues of interest to sociologists, including Fligstein and McAdam. Failure to take account of technologies is often failure to offer a full explanation of social events.

My argument is also not a one way street, down which historians and sociologists of technology come traipsing to offer their wares to field theorists. I argue that field theory can solve at least two problems in the study of technology, both of which arise from concerns—nay, outright fears—of technological determinism. Scholars dread that they might fall prey to any argument in which a technology somehow *causes* social changes. For this reason, although many scholars come to the study of technology before being ordained into the academy because they are interested in how technology seems to influence society, they end up focusing on how technology is "socially constructed," meaning how various social forces came together to give a technology its final shape. Some call this "social determinism." It leads to at least two complications: first, scholars tend to focus on the internal, or "contextual," development of technologies and technological systems, not on how people use those technologies in the wider social field.¹ Second, scholars bend over backwards trying to develop terminology that will allow them to account for the apparent *influence* of technology without falling prey to technological determinism. This contortionism has led to some strange results, most

¹ Internal narratives of development focus only on the decisions of inventors and others made in developing a technology, while contextual treatments, which are more common these days, broaden this analysis to include various social pressures and factors. [Staudenmaier 1989]

notably Actor Network Theory, which handles the issue of determinism by doing away with the distinction between human actors and technologies, which it refers to as “actants.” Field theory may give us a way of overcoming these troubles.

This essay proceeds through four main sections. In the first section, I briefly summarize the essential parts of Fligstein and McAdam’s theory of fields. While other contending field theories exist, theirs is the most recent major statement, and it is also the most synthetic and comprehensive theory that we have. Then I turn to the three main sections. I examine some ways that technologies play important roles in social fields in the second section. McAdam and Fligstein focus on social movements and organizations—their respective areas of expertise—in their account of fields. For this reason, I will also emphasize these two areas, showing the part of technologies in each of them. I also briefly examine the kinds of fields that most interested Bourdieu. In the third section, I show how some parts of John Levi Martin’s account of field theory can help overcome the technological determinism-social determinism divide. Although Martin and Fligstein and McAdam cite each other as fellow field theorists, they have slightly different accounts, which they have not rectified so far (to my knowledge). My goal here is not to resolve this difference for them. Rather, I suggest that Martin’s examinations of human perception and action, which are important to his account of fields, give us a way of overcoming a significant cul-de-sac in technology studies—the issue of causality. Finally, I show in the fourth section how various streams of technology studies have given a subtler and richer account of governance than has been so far afforded by field theorists, and I argue that these richer accounts of governance have arisen particularly when scholars pay attention to the role of technology in these processes. In other words, after showing the significant overlap between field theory and technology studies in the second section, I show how field theory can be useful to technology studies in the third one, and vice versa in the fourth.

A Brief Synopsis of Fligstein’s and McAdam’s Field Theory

For the majority of this essay, I will be focusing on strategic action fields (McAdam and Fligstein 2011; 2012), otherwise known as fields of contestation (Martin 2011) or fields of organized striving (Martin 2003). McAdam and Fligstein define a strategic action field as a “constructed meso-level social order in which actors (who can be individual or collective) are attuned to and interact with one another on the basis of shared (which is not to say consensual) understandings of the purposes of the field, relationships to others in the field (including who has power and why), and the rules governing legitimate actions in the field.” (2012, 9) Fields typically feature some limited resource (money, status, power) toward which actors are oriented. They usually involve at least some competition, but they can also contain a fair amount of cooperation. Some fields, like fields of interest among academics and hobbyists or fields that celebrate communality and solidarity, such as hacker, maker, and open source software groups, may have a great deal more cooperation than competition. (Douglas 1989; Reagle 2007)

Another important feature of fields is that they are nested, like Russian dolls, to use Fligstein and McAdam’s metaphor. To draw an example from business, individuals in an office or business division would belong to a field; the different offices and divisions within a company would belong to a higher order field; and finally that company would compete with others in a still higher field, often called a sector. There are even cases where sectors compete with one another, such as when ethanol producers try to shape regulation to take market share from the petroleum industry. Fields also

can be divided up in seemingly infinite ways. One division in a company might be riven by struggles between engineers and graduates of business schools, for instance, and conservative politics in the US often features contestation between libertarians and theocrats.

Perhaps the greatest challenge for field theorists is to define when a field has emerged, and what distinguishes a field from a random sample of unrelated people or groups. It is likewise challenging to pinpoint, conversely, when a field has faded away. To some degree recognizing a field is like recognizing something obscene: you know it when you see it. But we can go further than this. A helpful place to begin is with Jean-Paul Sartre's notion of a "serial collective." Imagine, as Sartre does, a number of people, complete strangers to one another, waiting for a bus. These people will never see each other again, and they all know that the buses run at such regular intervals that they will not have to push, angle, or compete for a seat. These people are only in a "group" in the sense that they happen to be in the same place at the same time; they only form a serial in Sartre's terms; as bus-waiters, they are not members of a field. We can imagine scenarios where this would change, however. For instance, the group may find out that the bus company is going to change the routes and rally together to fight this change; or after they get on the bus, the bus driver might be drunk and crash the bus, which might bring the passengers together as plaintiffs in a legal suit; or sitting in style at bus stops might become a new hip, ironic activity for some punk subculture, and this particular bus stop might be the most important place in the city for the punks, all dressed up in leather, pierced, and tatted, to show off their disinterested, insouciant bus stop sitting style. That is, something could bring the people waiting together as a serial collective at the bus stop into a field.

Let's look at one other example—a music concert at a major venue—to examine the difference between collectives that are fields rather than non-fields. When a band's fans turn up at a concert hall, they are not part of a field but rather consist only as a serial collective. They will disperse anonymously into the night, and they are not typically competing for anything. (Perhaps a few regular groupies who follow the band from city to city vie for the attention of the stars backstage—the groupie scene could be its own field.) The band certainly is competing in a field, however; it contends with other bands and musical acts for the attention and money of listeners. The band has a number of potential strategies open to it through which it can compete, including social media, hiring a press agent and manager, and perhaps drawing on the resources of a record label, which might fund advertising and push to get the band airtime on radio or other media. Yet, musical audiences *can* become fields in themselves, or at least important places where some social fields play out. For instance, opera houses were at one time central arenas of social status among relatively small, close-knit, elite communities. The spaces were filled with the kinds of drama, social climbing, and intrigues that filmmakers and novelists love, as we see in the account that Balzac gave in his story, "Sarrasine." Similarly, *music scenes* often have complex social hierarchies, games of status, and idiosyncratic rituals of belonging. In other words, there is always a fine line between those gatherings of people that are serial collectives and those that are fields.

Fields are also populated with various kinds of actors. Borrowing terminology from Gamson (1975), Fligstein and McAdam posit that fields often consist of "incumbents," typically long-standing actors who hold a great deal of power and "disproportionate influence" in a field, and "challengers," upstart actors who hope to

push the reigning power aside and make themselves the new incumbents. Actors, whether individual or collective, have varying sets of “social skill,” which allows them to succeed in a field. (Fligstein 2001) The required skills are often field specific: the right kind of tools for becoming a prestigious computer scientist will not necessarily make someone a famous performance artist, though some “skills,” such as being affable and persuasive, may cross such lines. Fligstein and McAdam also emphasize the role of “governance units,” which set the rules of fields. Governance units need not be governments, and, indeed, in a liberal society like the United States, typically aren’t. Fligstein and McAdam differentiate between states (or governments), which can set rules for any field within their jurisdiction, and governance units that are internal to a single field. Professional societies set rules for members; trade associations and standards bodies govern industries; and ethics advisory panels and institutional review boards set limits on practices at hospitals and universities.

Finally, fields experience different kinds of events. They often assume some stable form over time but external and internal events can destabilize them. First, “exogenous shocks” can send effects spilling over from an external field into the one under consideration. One of the hallmarks of modernity has been the stitching together of fields, through activities like developing national and international financial markets and developing extensive supply chains and through the rise of the nation-state itself. Fligstein and McAdam note that this interdependence creates a “rolling turbulence” in society, as changes in one field comes to have consequences for others. An exogenous shock could be an event, such as a war or epidemic, with massive consequences in many fields, or it could be a more limited event, such as when a downturn in the housing market creates problems for construction firms. Second, a field can enter an “episode of contention” in which one or more challengers makes a play to usurp the position of one or more incumbents. McAdam (2007) noted that these attempts by challengers often appear to be moments of significant innovation. Lastly, regardless of what changes arise because exogenous shocks and episodes of contention, fields tend to reenter periods of stable “institutional settlement.” With this minimal set of features, actors, and events, we have the basic field theory starter kit. The remaining sections will bring these ideas into dialogue with technology studies.

Social Movements, Organizations, Bourdieuan Fields, and Technologies

Over the past thirty to forty years, one fairly constant tenant in technology studies has been that the invention, development, diffusion, and use of technologies largely depends on “context.” Contextualists argue that few worthwhile generalities can be made about technology; those that can be made are mostly inane. This disparagement of generalizations might also apply to how technologies fit into different kinds and levels of fields, but as I hope to demonstrate, there are technological isomorphisms that mirror the institutional isomorphisms between fields, and these similarities lead to new insights and questions. (DiMaggio and Powell 1983) Some of the questions that we have learned how to ask about technologies in organizations, for instance, we should also ask of technologies in social movements. In the following subsections, I will examine the roles of technologies in social movements, organizations, and Bourdieuan (professional) fields.

Social Movements

Technologies can play several different roles in and around social movements: First, social power stems in large part from access to technologies, which explains how social movements often contest access to and control over technologies themselves. The role of technologies in power includes the issue of work, which often comes down to who will use which tools to do what. Power includes the possibility to adopt technologies that render some workers altogether obsolescent, leading to “technological unemployment.” (Noble 1986; Bix 2001) Karl Marx knew all of this. His political visions entailed changing the relations of production (the division of labor and property) around the forces of production (technology). Additionally, some scholars assert that technologies themselves can have “political qualities.” Langdon Winner (1980) famously argued that these qualities can take two forms: in the first, power is designed into the system. Winner used the notorious, if perhaps apocryphal, case of Robert Moses building bridges so low on the Long Island’s Wantagh Parkway that buses could not use the road. According to Winner (who built on Robert Caro’s biography of Moses), Moses designed the bridges in this way to keep the kinds of—mostly lower-class and especially black—people who used public transportation from getting to his prized beaches. Winner’s point was that technological systems can be built in such a way that they preserve the status quo of social power. Winner’s second form of political quality involves technologies that are “inherently political,” situations in which “the adoption of a given technical system unavoidably brings with it conditions for human relationships that have a distinctive political cast.” (Winner 1980: 128) As Winner writes, “Taking the most obvious example, the atom bomb is an inherently political artifact. As long as it exists at all, its lethal properties demand that it be controlled by a centralized, rigidly hierarchical chain of command closed to all influences that might make its workings unpredictable.” (Winner 1980: 131) Many readers might resist Winner’s notion of “inherent politics,” pointing to the historical genesis of the atom bomb and the systems of power that accompanied it. Still, most societies deem some technologies to be so dangerous that they necessarily require a security regime of some sort. Technology then is often tied to power, though in different ways. It is not surprising, therefore, that social movements, whether anti-automation labor unions or anti-nuke peace activists, often focus on changing our relationships with technology; nor is it surprising that they often *use* technologies to carry out their efforts.

Second, leaders and participants in social movements often use communication technologies to coordinate and publicize their social movements. For example, scholars have long argued that the printing press played a key part in the Reformation, as lay people had new access to the Bible in their native languages. (McLuhan 1962; Ong 1967; Eisenstein 1980) Similarly, for several decades, historians have drawn attention to the importance of pamphlets in the American Revolution. (Schlesinger 1935; Bailyn 1967; Botein 1975) We have recently heard a great deal about these kinds of ideas because of the role of digital communications technologies and social media in protest movements and uprisings, several of which were characterized as “Twitter Revolutions.” There are many ways to respond to these too-simple pictures of the role communications technologies played in these events, including the denial that technology determined them. Instead, we often see considerable innovation around communications on the part of activists. For instance, during the Tiananmen Square uprising, activists apparently circumvented the Chinese government’s tapped phone lines by using fax machines, which were uncontrolled. (Time Magazine; NYTs) To note another example, when the Egyptian government shut down the Internet during the

Revolution of 2011, activists used dial-up modems, ham radios, and fax machines to get information about events to the outside world.² They also used blogs to pass around information on how to use dial-up modems to many who had never had to do so before, or had long since forgotten how.³ The Chinese and Egyptian cases show that sometimes social movements use new technologies that incumbents have not yet put under control, while other times they must jerry-rig communication paths using ad hoc, even seemingly obsolescent, systems. Finally, in their excellent analyses of the role of technologies in South African anti-apartheid movement, R. Kelly Garrett and Paul Edwards (2007) have shown, among many things, how activists with limited technical knowledge created their own technical systems, including basic cryptography and codes, to overcome surveillance. (As an important counter example to the centrality of technologies in social resistance, Robert Darnton [2010], tired of people arguing that the Internet gave rise to social networks, has shown how rebellious Parisians in the late 18th century passed around subversive poetry through a mostly oral culture.)

The ways that individuals and groups use technologies to coordinate and conduct social movements goes well beyond communication technologies. Transportation on its own could make up a third way that technologies fit into the strategies and social skills of social movement groups. By reflecting on technologies in the Civil Rights Movement, particularly in the Birmingham Bus Boycott, can show how these three roles of technologies can work together, dynamically. Indeed, many struggles in the movement were over technologies themselves. Access to technologies and their benefits made up a central part of the movement's hopes—not only as evinced in the Birmingham Bus Boycott and the opening actions of Rosa Parks, but also in the Freedom Riders challenge to segregated interstate bus travel and the sit-ins that took aim at the desegregation of public technologies, like drinking fountains, bathrooms, and lunch counters.⁴ Second, people used the mimeograph machine as an important tool to get out information and coordinate action in Birmingham and other locales, fitting accounts of the centrality of printing presses for social movements in pre-digital eras. Finally, the personal automobile helped boycotters get to and from work and other necessary activities. The boycotters and their leaders composed carpooling systems that enabled people to substitute one mode of transportation for another. A pivotal change in historical memory has been the shift in viewing Rosa Parks as a tired, fed up black woman who refused to give up her seat in the face of an unjust system to remembering that she was activist and *organizer*, who trained at the Highlander Folk School. And that is the thing: people use technologies as crucial elements in their struggles to get things organized.

With these thoughts in mind, we can draw a few conclusions and ask a few questions. Technologies—which represent the sum total of human actions that have created and implemented them—partly define the possibilities of action. Put another way using a game metaphor, technologies will not force an actor to make one move or

² <http://www.bbc.co.uk/news/technology-12322948>

³ <http://manalaa.net/dialup>

⁴ I am focusing mostly on modern technological artifacts, devices, and systems in this essay. Some broader definitions of technology, often drawing on the Greek notion of *Techne*, focus on all human techniques and forms of instrumental rationality. From this perspective, for instance, secret ballot voting is a technology used to run electoral democracies, and the Civil Rights Movement put a great deal of effort into getting African Americans the right to vote. Taking this extensive definition of technology may be helpful in certain circumstances, but I will stick with the narrow definition here.

another but they will shape which moves on the field are open. If blacks in Birmingham had earlier depended on, say, electric streetcars and not had an alternative transportation system, like the automobile, it would have been quite a bit more difficult, if not impossible, to hold the boycott. This additional difficulty may have lowered morale over time, leading the boycott to fail prematurely. Alternative transportation aided the movement's resistance to the oppression that went along with another mode of transport. (Of course, to go further and say that the automobile somehow caused the boycott would be more than stupid; it would be degrading; this is a big problem with the notion of technological determinism, as I discuss below.) Between communications, transportation, and other technologies, in Fligsteins and McAdam's terms, the fate of political challengers who make up a social movement often depends on how successfully they take up and use available technologies.

There are many questions to ask about social movements, and to some degree some questions that economists and historians long ago learned to ask about technologies in economies remain unanswered vis-à-vis social movements. For example, several decades ago, the economist, Nathan Rosenberg, described how a wide variety of industries in the 19th century adopted a few basic metal-production technologies and techniques. Knowledge about these technologies moved from industry to industry, bringing each in line with the other in what Rosenberg called "technological convergence." Do we see similar dynamics in social movements? Who, for instance, owned the mimeograph machines in Birmingham and how had people gained previous experiences using those devices? Was it the NAACP? Or was it the churches? What kinds of coordinating and publicizing were people doing with those machines before the boycott? Do we see knowledge of how to use technologies move between sites of contest? Did knowledge of how to create carpooling systems move between boycott sites? Or were they recreated at each one? We could ask similar questions about the Arab Spring. We know that the various national movements took inspiration and enthusiasm from one another, for instance, as the Tunisian rapper El Général's songs of resistance received a great many views on Youtube. But did any learning happen from place to place? Or were the technologies that were a part of organizing (Twitter, other social media sites) so intuitive and already such a part of daily life that no learning was required? Finally, I have focused so far on non-violent social movements, but another important factor is how violent groups obtain and use arms, whether that involves the development of guerilla tactics in the Irish Republican Army (Townshend 1979) or the development of and transfer of knowledge about the car bomb (Davis 2007).

Organizations

All organizations use technologies to achieve ends. Chandlerian business historians, Schumpeterian and evolutionary economists, Carnegie School organizational theorists, and Porterian competitive strategists have created substantial literatures on this topic, nearly all of which focuses on technologies in corporations. (For this reason, this work does not emphasize the kinds of isomorphisms between social spheres that field theory successfully highlights. The possibility that knowledge of coordination and other matters could move between, say, businesses, activist groups, and non-profit organizations remains largely unexplored.) So, perhaps it makes the most sense to start with the place of technologies in firms. Technologies play three primary roles in businesses: they aid in coordination; they improve and reduce the costs of processes; and they are end products on which firms compete.

A critical technological sign that a group has shifted from being a loose affiliation or movement to being an organization is when the group gets an office, at least partly filled with equipment, furniture, and working surfaces. The organizational explosion of the late 19th and early 20th century boomed concurrently with rapid, post-typewriter developments in office technology.⁵ Communications, computing, and technologies of ordering and cataloging enabled managers to increase control of internal firm functions (or at least aspire to) and to adopt new office and communication technologies. (Beniger 1986; Yates 1989). In the 1990s, business theorists became interested in dynamic capabilities, that is, not in static sets of skills that allowed a firm to continue along its chosen path but sets of meta-skills that enabled firms to respond dynamically to their changing environments. An early contribution to this literature showed how Wal-Mart built flexible communications and knowledge systems—including video conferencing technologies, computer-based logistics systems, private jets, and satellite communications—that allowed them to respond quickly to evolving circumstances. (Stalk, Evans, and Shulman 1992) Communications and information management systems enable firms not only to organize their internal processes but also to learn about and react to changes in the outside world, including what the competitors in their field or sector are doing. At the same time, in the 1990s, scholars found that information and communication technologies did not lead to the expected productivity gains. (Brynjolfsson 1993) We now have the image of a technologically well-heeled office full of people watching cute kitten videos and messing around on Facebook. Still and all, just as in the case of social movements, businesses use communications technologies to organize.

Firms compete in their fields not only on their capabilities but also on the quality and price of their products, and technology is also central here. Process innovation improves the efficiency of companies' internal activities and reduces costs. Importantly, the large firms that so interested Alfred Chandler were businesses, such as manufacturing, chemical, and communications companies, that could achieve significant economies of scale—largely for technological reasons. Companies used production technologies, and eventually automation, to increase throughput and shave costs and, therefore, prices. Yet, not every firm produces the kinds of goods, nor uses the kinds of technologies, that allow for this kind of scale up—an insight that has liberated business historians to focus increasingly on “non-Chandlerian” firms. (Scranton 1997)

These initial insights about the role of technologies in firm processes open up a series of additional questions of interest. For instance, how do firms learn how to organize and coordinate their activities and their use of technologies? Kenneth Arrow (1962) emphasized the role of “learning by doing”: firms increased productivity simply through experience and not necessarily by acquiring new technologies. Arrow, like many organizational thinkers of his day, continued the American pragmatist line when he wrote, “Learning is the product of experience. Learning can only take place through the attempt to solve a problem and therefore only takes place during activity. Even the Gestalt and other field theorists, who stress the role of insight in the solution of problems (Köhler’s famous apes), have to assign a significant role to previous experiences in modifying the individual’s perception.” (Arrow 1962: 155; I return to Köhler and the pragmatists below.) Additionally, Nelson and Winter (1982) developed

⁵ For some readers, there may be a whiff of technological determinism here, but I will address that in the next section.

theory model of evolutionary economics, in which firms develop sets of interpersonal routines (which link together lower order habits in individual people) through which the firms compete with others. Technologies are often essential parts of the routines and the habits that comprise them. Another way that firms acquire new know-how about technologies and improving processes is by hiring in skilled, knowledgeable people. In his history of mass production in the United States, David Hounshell (1984) demonstrated that entrepreneurs and managers carried knowledge of how to organize workers and production technologies to increase output as they moved from industry to industry, beginning in the military armories and advancing through industries, like sewing machines and bicycles, and culminating with the sector most highly-associated with mass production, the auto industry. Hounshell gave significant flesh to Rosenberg's notion of technological convergence, though he also showed that the transition towards mass production and interchangeable parts was not nearly as smooth as earlier writers had imagined.

This point brings us to the third and final way that technologies matter to firms: as products. Many corporations produce technologies and compete over market share.⁶ Business history is replete with stories of such competitions. For instance, the Ford Motor Company, which for nearly twenty years ran on a business model that included only one consumer automobile (the Model T), finally had to adopt annual model changes as General Motors began racing away with most car buyers. The more recent history of computing and the Internet has many famous and well-known stories of tough rivalries, such as that between Microsoft and Apple, of between different browser makers, or between different search engines. The favorite storylines are ones in which an upstart challenger comes along and eats all of the incumbents' lunches.

Stories of firms competing over technologies have tended to focus on cases of "radical innovation" and Schumpeterian change, and these types of developments are crucial for thinking about technologies in fields. Just as change in a nearby field can induce change in another, a new or significantly altered technology can encourage change in a seemingly distant field. For instance, few wanted to be in the dial-up modem industry by the early 2000s, when cable and DSL broadband technologies had replaced these devices in most cities. (For the earlier history of competition in the modem industry, see Pelkey) We see similar dynamics when the phone, fax, and email technologies eventually rendered telegraphy obsolete, and when the internal combustion engine-equipped automobiles beat out steam and electric ones in the early 20th century.

Yet, the focus on "radical innovations" can obscure the significance of small incremental changes in firm processes and products. Incremental changes are essential not only to a business that is trying to lower costs and, therefore, increase profits but also to that business's customers. Over time, incremental cost changes can influence possibilities in other fields. To return to the example of personal automobile use in Birmingham, much of the widespread adoption of this technology resulted from incremental, cost-shaving efforts by the automakers, as well as from the development of

⁶ Technologies as products less often play an important role in social movements, but there are exceptions to this rule. Gandhi's Civil Disobedience Movement focused on producing salt and homespun cloth. Environmentalist and anti-capitalist movements sometimes envision more sustainable and humane production, whether in the form of the *Whole Earth Catalog*, Amory Lovins' "soft path," Buckminster Fuller's Synergetics and Dymaxion technologies, or the work of various hacker, maker, and open source groups.

the used car market and the expansion of consumer credit. (Although African Americans would not likely have had access to auto credit themselves, *white* access to consumer credit may have encouraged turnover in the used car market.) As many automotive historians have noted, the great democratization of that technology began when Henry Ford introduced his system of mass production, extensively reducing the price of the Model T over the following years. What we have not fully appreciated is how these incremental cost reductions may have had repercussions in distant, non-obvious fields, like Civil Rights.

Scholars have not given as much attention to how communications, computing, and other technologies fit in government and other non-business organizations. Quite a bit has been written about the role the US government, and especially the military, played in developing computers, the Internet, and other such technologies. And, of course, military historians have shed vast amounts of ink detailing the development of military technologies and how strategists reformed tactics around those technologies' new potentials. The literature on technologies in domestic government is slimmer. Some histories written in the last decade have examined how decision-makers adopted computers into the White House (Laprise 2009) and other parts of the government (McGee 2012). Others have described how the RAND Corporation took the techniques it had developed for examining military and nuclear defense strategy, many of which involved computer-aided mathematics, and began applying them to social welfare policies, economics, and other non-military issues. (Hounshell 2000; Jardini 2000; Light 2005) To cite one final example of how complicated these stories can get, Robert McNamara took the mathematical skills he learned in the military during World War II with him to the Ford Motor Company, where he was one of the "Whiz Kids" before eventually becoming the President of the company. Then, in 1960, McNamara turned around and took his experiences as the head of a corporation back to the military, when he became the Secretary of Defense. There has been tremendous organizational and technological learning between the different spheres of fields—governmental, private, non-profit.

Bourdieuian Fields

I have focused so far on how technologies fit into the kinds of fields emphasized by Fligstein and McAdam, namely social movements and organizations, but I also . There are other kinds of fields, perhaps best typed as "professional fields," that most interested one of the founding field thinkers, Pierre Bourdieu and deserve brief consideration. Bourdieu wrote several well-known studies of professions ranging from civil service to art, from science to literature. Bourdieu mostly focused on how actors in these fields gained prestige and rank. What are some of the ways that technologies fit into these kinds of fields? Often, the answer depends on how nations organize and distribute power to the professions. In a particularly rich example, Shane Hamilton (2008), has shown how long-haul truckers took on a new social position and status in the United States after World War II, when federal policy favored trucking over shipping via rail. In this case, shifts in technology regulation allowed for shifts in professional fields. Likewise, in his recent book, *The Computer Boys Take Over*, Nathan Ensmenger (2010) described how computer specialists (e.g., programmers, IT support people) moved, with their machines, into already-existing organizations. As the mediators between non-specialists and the computers, these "nerds" gained a great deal

of power but also faced significant resistance from people who resented both the specialists' power and their dorky ways. We can see similar stories elsewhere.

Margaret Curnutte (2011) has examined how direct-to-consumer (DTC) genetic testing industry, through which consumers are able to order genetic tests via the mail, has challenged the traditional authority of medical doctors. (On the history of professional medical authority in the US, Starr 1984) Different nations have created divergent policies regulating DTC tests. Germany has banned them altogether, while the US federal government has allowed them to go mostly unregulated (a few states have banned them). As Curnutte notes, US medical doctors have repeatedly made public declarations against the tests and questioned the ordinary consumer's ability both to interpret the results and to cope psychologically and existentially with potentially devastating test results. Meanwhile, the DTC companies have themselves become interpreters of the data, and at least one has created a Facebook-like social media site, where people who have taken the test can interact with one another. Medicine, much to doctors' chagrin, has shifted from the waiting room to the chat room.

If we examine how communication and computing technologies have moved into government, we will find that they often have complex relationships to the tradition of civil service in a country. Comparative bureaucracy studies have shown that nations differ in terms of how much they use seniority or merit to organize their civil service. (Silberman 1993) In a simple comparison of Western nations, the French system is more hierarchical and based on seniority than the American system, which is more flexible. The character of national bureaucracies also constrains how technologies can move into government because technologies often require the presence of people with new skill sets. For instance, in the United States, during the energy crises of the 1970s, young operations researchers, experts in computer modeling, were able to move quickly into influential positions in the federal government, which may not have been as true in more hierarchical, seniority-centric nations. (Vinsel 2011) Clearly, these kinds of changes around professions and technologies can have effects in higher-order fields, as when computer workers and computers shift the operations of a business or even the practices of an entire sector.

The sociology of science is, of course, its own enormous literature. Historians and sociologists of science have recently become interested in the role that instruments (technologies) play in science, though few of these studies focus centrally on fields. Yet, Knorr-Cetina (1999) has shown how the division of labor in two different scientific disciplines, high energy physics and molecular biology, varies in ways largely dependent on the kinds of technologies used in the fields and the kinds of work required around those technologies. Thus, molecular biology labs have a two-citizen model, wherein lab technicians have much lower status than the people in charge of the experiments. This division opens up the potential, for instance, for some forms of resentment largely lacking in high energy physics.

We might also examine the role of technologies in the art world. Art always involves technologies of some sort, even if it is simply a brush or clay, as John Dewey and Lewis Mumford recognized in the early 20th century. (Dewey 1934; Mumford 1952) But more recent developments in art, including video art, installation art, and computer-aided design, centrally feature more complex technologies. Moreover, the social skill involved in succeeding as an artist often involves not only being able to use technologies but also knowing how to talk about their role in the art form or even in society as a whole. For example, the video artist Nam June Paik by definition made

videos. But another important skill of his was talking about the influence of video and electronic media on society. In a 1974 grant application, Paik argued that the present society was experiencing struggles over how to move and educate people, as evidenced by struggles over school busing. “But,” he wrote, “television power can help achieve integration and understanding, and it has the added advantage that it happens over the air, unhampered by our polluted and complicated earth.”⁷ These potentials would require a number of basic investments, he believed, invoking the New Deal. “The building of new ELECTRONIC SUPER HIGHWAYS will become an even huger enterprise. Assuming we connect New York with Los Angeles by means of an electronic telecommunication network that operates in strong transmission ranges, as well as with continental satellites, wave guides, bundled coaxial cable, and later also via laser beam fiber optics: the expenditure would be about the same as for a moon landing, except that the benefits in term of by-products would be greater.” In other words, the movement of cutting-edge technologies into art has usually been accompanied by the ability (and social skill) to talk about it and to talk it up. Of course, the transition of technology into fields like the arts is not always a smooth process. Architects have increasingly turned to computer-based models and designs, sometimes seemingly as an end in itself, with the results printed in professional architecture journals and magazines. But some have pushed back against this trend, believing that it undermines the profession’s traditional role of designing material structures. (Picon 2010)

Finally, scholars have recently examined how Bourdieuan types fields form around technologies themselves. Susan Douglas (1989) has shown how amateur communities formed around early radio technologies. Ann Johnson (2009; 2012) has described how “knowledge communities” form around technical problems in specific technologies, including antilock braking systems and, in a more recent study, electronic engine controls. And Cyrus Mody (2011) has detailed how an “instrumental community” formed around scanning tunneling microscopes and eventually led to the formation of the scientific-technical field of nanotechnology.

In this section, I have explored the significant overlap between works in field theory and works that have studied technologies in society. In the following two sections, I go further arguing that field theory and technology studies truly need each other.

Fields, Choices, and Technologies

What is the relationship between technological change and social change? As John Staudenmaier has shown, since the 1959 founding of *Technology and Culture*, the central journal in the history of technology, historians have been arguing that the relationship is *not* one in which technology determines society (technological determinism). Scholars struggle to balance the truism that the adoption of technologies gives us different capabilities and sometimes the loss of others (the philosopher Ernest Kapp called technologies “organ projections”; Winner (1986) called them “artificial aids to human activity”) with the risk of saying that technologies were the *causes* of social change. Yet, the spectre of technological determinism continued to haunt people studying technology; it would not go away. Perhaps the most famous technological deterministic statement is Karl Marx’s line in *The Poverty of Philosophy*, “The hand-mill gives you society with the feudal lord; the steam-mill, society with the industrial

⁷ <http://www.medienkunstnetz.de/source-text/33/>

capitalist.” (Marx 1920; others have argued that this statement is an outlier for Marx and that he gives a much more nuanced account of technology in *Capital* [MacKenzie 1996]) The core text dealing with the topic of technological determinism contains the following list of technological deterministic arguments: “The automobile created suburbia.’ ‘The atomic bomb divested Congress of its power to declare war.’ ‘The mechanical cotton-picker set of the migration of southern black farm workers to northern cities.’ ‘The robots put the riveter out of work.’ ‘The Pill produced a sexual revolution.’” (Smith and Marx 1994: xi) To this list, we could add several other examples, including the famous argument that the air conditioner changed southern culture. (Arsenault 1994)

One response to notions of technological determinism was to say that people shaped technology, not the other way around. But there are deep ambiguities in the word “shaped.” It simply does not play the same role or work at the same scale in sentences like “The Pill shaped the sexual revolution” and “Scientific researchers shaped the Pill.” By the 1980s, the sociologists Wiebe Bijker and Trevor Pinch were laying out their well-known analysis of the “social construction of technology” (which they dubbed SCOT).⁸ Their analysis gave a great deal of agency to their actors, but also seemed to do away with any strong notion of power. Their explanation gained widespread acceptance amongst historians and sociologists of technology, but not everyone was content. Earlier, David Noble had argued that corporate selection of automated computer-numerically controlled (CNC) machines fit the classic division, dear to Marxists and labor organizers, between management and labor. The historian, Thomas Hughes, who spent most of his career examining large technological systems, argued that although many divergent paths were open when systems first developed, they eventually gained self-reinforcing “momentum” (what others call “path dependency”). For some, Hughes’ momentum stunk too much of technological determinism, however, and it made few truly happy. Then in the mid-to-late-1980s, French theorists, most famously Bruno Latour and Michel Callon, began developing a framework they called “Actor-Network Theory.” A number of problems in ANT forbid widespread uptake of it in the academic circles. (For a brief review of some long-standing criticisms of ANT, see Sismondo 2011) The social construction still largely reigns as the central paradigm in the history and sociology of technology, but every year scholars show up to conferences, like the Society for the History of Technology, and agonize over what will come next.

One version of field theory may help resolve the antinomies surrounding technological determinism. John Levi Martin’s writings on field theory form part of a larger project, which seeks to overcome certain models of social scientific explanation, namely explanations that claim to have access some cause of people’s behavior to which those people themselves do not have access. As Martin puts it, “sociology and its near kin have adopted an understanding of theoretical explanation that privileges ‘third-

⁸ We should be careful to define the meaning of “constructionism” here. In many fields, including the history of science, constructionism denotes a view that examines how people reach interpersonally defined ideas about the world (which have some indeterminate and usually held-to-be undeterminable relation to “reality”). (Martin 2003) Constructionism in this sense often looks at significant moments when ideas were changing, and it does so by tracking “discourse” and other such transpersonal entities. Constructionism in technologies *can* include this epistemological view. For instance, some (uncertain and undeterminable) ideas about cancer risk may undergird how a form of plastics is regulated and, thereby, influence how that form of plastics takes its final shape. But just as often, scholars in technology studies basically simply examine how various groups or interests give form (e.g. “construct”) some technology, leaving hairy epistemological issues largely to the side.

person' explanations and, in particular, have decided that the best explanation is a 'causal' third-person explanation, in which we attribute causal power to something other than flesh-and-blood individuals." (Martin 2011: 5) He goes on to argue that for many theories the best causal explanations are the ones that are the farthest "removed from the self-conceptions of actors." (Martin 2011: 6) Martin believes that this insistence on third-person explanations comes from two sources, the authoritarian Freudian tradition, in which the analyst knows better than the analysis; and, and the Durkheimian line, with its neo-Kantian model of a "grid of perception" (accessible only? to the social scientist) lying behind—and indeed causing—human perception and action. Between these two traditions, social scientists hold that social science method somehow produces a better and more reliable explanation than first person reporting.

Worries about technological determinism and Martin's apprehensions about any "sociopathic epistemology" that automatically sets aside actor's accounts for their choices in favor of counterintuitive explanations share a major intersecting point: the notion of "cause." Critics of technological determinism maintain that we are wrong to say that technologies cause social changes, that is, that they determine human action; people cause such changes—they *act*. Meanwhile, Martin resists the social scientific urge to root around for general, abstract causes under or behind human actions. A striking parallelism exists between these concerns. In fact, I think they are the same concern. They ultimately arise from discomfort over the idea that something lies under or behind a person's self-understanding and stated reasons and causes their actions. Such explanations both remove moral responsibility from actors and are degrading in that they do not recognize accomplishment (for example, if I argued that the personal automobile *caused* the Birmingham Bus Boycott, I would, thereby, cover over the risks taken and courage mustered by the boycotters).

Martin sets aside this doubt in actors' accounts not only by assuring us of their self-understandings (that people usually know their reasons) but also by giving us reasons to have faith in our perceptions of the world. The Durkheimian model of action, which we can also see in the writings of avid Durkheimians, like Mary Douglas, goes like this: Perceptions enter through the senses into the (culturally-bound or socially-constructed) grid of perception before giving rise to action. The actor has only imperfect awareness of the grid and what it is doing, whereas the social scientist somehow has a richer but still imperfect perspective onto it.

Martin draws upon three different schools of thought—the Russian activity school, the German Gestalt psychologists, and the American pragmatists—as well as a dose of phenomenology to offer up an alternative view. A common thread of these four approaches is that, as the Gestalt psychologist Wolfgang Kohler argued, "phenomenologically, value is located in objects and occurrences." (Quoted in Martin 2011: 167) That is, we experience things as possessing value, and these values are defined, in pragmatic fashion, by our projects. The Durkheimian vision of action, which proceeds from perception through the grid of perception to action, is then inverted. Our goals and the actions they entail lead to us seeing value in the world. If I want to hang something on the wall, a pear, unless tremendously unripe, is less than useless; if I am hungry, a hammer will do me no direct good.

Martin goes further, following Stephen Pepper, to argue that we sometimes experience objects as having an "ought," that is, that the world sometimes makes demands on us. (Martin 2011: 243) He cites Kohler's experiments with apes, in which the apes were able to negotiate their ways past obstacles until they came too close to the

object of desire, at which point the object gave off such a magnet- or gravity-like pull that the apes were unable to think about anything but it. This analogy with primates may seem a stretch, and, for the purposes of this essay, we do not need to follow Martin in believing that objects call us to certain kinds of actions. But then, perhaps one or two readers will know someone who has gone deeply, even disastrously, in debt buying coveted houses, cars, and consumer goods.

For Martin, both the fact that we experience values as being in the world and the “ought” of objects brings us to a notion of field theory that includes strategic action fields but extends well beyond them. Field theory draws on examples from the natural sciences, especially classical electromagnetism, to put forward a view in which objects exist on a field and impelled towards new positions. Whether an object experiences these forces depends both the object’s position on the field (e.g. its nearness to or farness from the thing of potential desire) and the object’s characteristics. (An aluminum can will not be drawn to a magnet that a steel washer is already sticking to; if you loathe cookie dough ice cream, you will not be drawn to the carton of it that I am already tucking into with gusto.) Just as games can have spatial values (chess, soccer) or not (bridge, hangman), fields can have real spatial qualities of position or figurative ones. To give a spatial example, most of our daily habits can be examined in field theoretic terms as we move about and work to meet our desires, but people and organizations also make decisions based on where they fall in different kinds of rankings, which may not have any spatial component.

With these thoughts in mind let’s return to the theme of technological determinism. Most of the examples listed earlier as prime cases of technological determinist reasoning (the air conditioner → demise of southern culture, the automobile → suburbia, mechanical cotton picker → Great Migration, robots → unemployment, the Pill → sexual revolution) have more to do with widespread technological adoption and use than they do with issues involved in social construction during the design phases of these technologies.⁹ Technologies can be constructed any which way; if they are not adopted (“socially”), they will not be part of a social change. To return to Marx’s famous line about handlooms, if you do not understand why a capitalist would prefer a steam-mill to a hand-mill, you do not understand what it is to be a capitalist. It is similarly unremarkable to say that capitalists’ technological choices have real consequences for works and that workers often are not happy about it. Moreover, it is clear why people want some technologies, like heating and air-conditioning systems, which is not to say necessarily that the technologies present an ought. Indeed, moralists and environmentalists must argue that we *should* forgo such technologies, or at least cut back on their use, for the greater good (by creating less greenhouse gas emissions, for instance) rather than arguing that, upon reflection, we really just don’t want them. To overcome technological determinism, therefore, we do not need to focus so much on the *construction* of technological systems but on the *adoption* of them, and people often adopt technologies for complex, even multiple reasons. As Martin suggests, we will overcome many brambles—including, I add, the bramble called technological determinism—by attending to the reasons of our actors.

At this point, it may seem like I am trying to set aside the social construction of technology in favor of something else. I’m not. Social constructionist interpretations

⁹ The exception, perhaps, is the statement ‘The atomic bomb divested Congress of its power to declare war,’ but I will set this aside for now.

have taught us a great deal over the last thirty years, and it would be more than foolish to pitch those insights out. If as I will argue shortly, technologies have complex relationships to fields and our possible desires, social construction shows us how humans purposely change and design their world to fulfill those desires. There is a kind of feedback dynamic here, in which desires give birth to new technological potentials, which give birth to still further desires. I believe, however, both that social constructionism cannot account for most of the cases where deterministic arguments are made *and* that field theory can account for and envelop the insights of social constructionism. The reverse is not true, however: social constructionists cannot account for all of the insights of field theoretic analyses. Field theory can explain social constructionist interpretations because those interpretations usually fit a field theoretic model. Although neither scholars who use field theory nor social constructionism often acknowledge it, both are deeply influenced by the political theory of pluralism, which sees society and politics as a site of contending interest groups. The founder of theoretical pluralism was Arthur F. Bentley, a student of and eventually correspondent and co-author with John Dewey. That a pragmatist gave birth to this theory and that various thinkers alluded to so far in this essay, including Arrow, Martin, and Herbert Simon, are clearly influenced by the pragmatists gives some sense that we are dealing with deep intellectual and structural affinities here. (There is also, what Sidney Winter has termed, a “Dewey Revival” currently under way in organizational theory. See Cohen [2007] and Winter [forthcoming]) What Bentley and his later disciples called interests, social constructionists call “relevant social groups,” and they examine how these groups exert pressure so that technologies develop in the way they wish. Since a theory of strategic action fields can account for how, in the classic pluralist model, groups put pressure on government, then it can also envelop the social constructionist insights about relevant social groups and technologies. This fact will bring us to an examination of how technologies come to play a role in strategic action fields. First, however we must come to terms with the role technologies play in shaping—or making available—objects of desire and how technologies themselves come to be objects of desire.

Technologies, Desires, and Choices

Before connecting Martin’s insight about how we experience the world as value-laden to technologies in strategic action fields, allow me to use a mundane example first to tie his ideas to technologies in general. My hypothetical example is an ordinary phenomenon, namely someone in a contemporary American city desiring to eat a fast food burrito:

A person gets a hankering for a fast food burrito made just the way she likes it from a chain she frequents; yet, she is visiting a city that she barely knows. The first thing that should strike us about this case is how amazing it is that a person can go to an unknown city, desire a specific cooked food, and acquire it. As Eric Schlosser (2003), Michael Pollan (2006), Jonathan Safran Foer (2009), and other popular writers have reminded us constantly, our food is highly industrialized and standardized. How else, for instance, could one chunk of beef taste so remarkably dependably like another chunk of beef in cities hundreds of miles away from one another? Chains of chains of workers and technologies make this possible from the systems used to corral cows to the factories used to take them apart, including high-pressure water systems used to blast the last bits of muscle and tendons off the bones, from the industrial vats and ovens where the beef is

marinated and cooked to the refrigerated train cars and semitrucks that bring the mostly finished product to the city where our hungry actor sits. Of course, to say that these facts are amazing is not to say they are good, and plenty of people conspicuously abstain from fast food (“I never even step foot in McDonalds!”), even organizing movements against it, proclaiming “slow food” via t-shirts and bumper stickers. Furthermore, fast food burrito joints and other restaurants contain signs or send out advertisements promising us that their products only have certain technological origins, that their cows were not shot full of antibiotics, that their vegetables are not genetically-modified, that their chickens were allowed to roam free instead of sitting with four to ten other hens in a “battery” cage measuring 18” by 20”. Our actor doesn’t care about any of this; she wants her burrito. But how will she find it?

Luckily, our actor has traveled to the kind of city she understands, namely a Western one with streets laid out in a more or less comprehensible fashion (say, a grid). Moreover, the city has followed the tradition of naming those streets and even putting up signs bearing those names. To get to the restaurant, she might take a bus, a subway, a taxicab, or drive her own car. She might use a map or, more likely today, navigation software on her cellphone. Whether she goes by foot or by some vehicle, she is likely to stop several times on her way when electric signals tell her that it is not her turn to move. She could disobey the warnings the signals give (she learned what the colors of traffic signals mean when she was quite young), but she values her safety, and she doesn’t want to be hassled by police for breaking the law. If she is feeling lazy or has waited too long to eat and, therefore, has a headache, she may skip all of this and order delivery. The delivery person will come via bike or car.

Martin says that we perceive objects as having value and that the values depend on our position in a field. I have used this example to show some simple ways in which the value-laden world—and the objects that we choose—are undergirded by technological artifacts and systems. Most often, to have a desire is to want something that people have used technologies to process. In other words, between agricultural systems and transport, even our basic desire for food compels us to enter into actions that are highly mediated by technology. Our choices will most often depend on the available technologies and our position. Fitting field theory, “position” here can be physical; but it can also mean social position, whether that means having the wealth necessary to buy or use a technology or having the security clearance or corporate ID badge necessary to get at a given technology. Sticking to a spatial position example for a moment, our actor might desire a fast food burrito but be in a neighborhood that is not well served by the bus, nor does she want to fork over money to tip the delivery person. (A social position example might have our actor lack the money to both buy lunch *and* pay for her way via transport.) So, frustrated, she makes due with a tepid bowl of soup at a faux artisanal bread restaurant. The fact that desire is technologically-mediated obviously goes back to the origins of human culture. To desire fresh meat is (almost always) to depend on spears, bows and arrows, or some other implements used to kill an animal. To desire bread is to depend on the plow (or some related tool) and agricultural knowledge.

These considerations apply not only on how we come to choose things that depend on technology for their existence or proximity but also to how we choose technologies themselves. Technologies will or will not be valuable to us depending on our goals and projects. Many things can change about and around a technology to

increase its attraction. Perhaps the most common point of attractive change is price, but others include a technology's production quality and reliability and culture beliefs and taboos surrounding the object. These kinds of considerations sometimes lead scholars to ask if there are predictable reasons for why technologies are desirable. Efficiency, convenience, and saved labor more generally are perhaps the most common candidates, and there are many, many examples of things chosen for these reasons. At the same time, Ruth Schwartz Cohen (1983) has shown how some technologies that are thought to save labor (her examples were domestic cleaning technologies) actually increased it (because cleanliness standards went up with the new cleaning potentials). Additionally, sometimes technologies are chosen or rejected for cultural reasons that have nothing to do with efficiency or effectiveness. (Perrin 1979) Still other cases are fall on a borderline. In a well-known article, Paul David (1985) argues that the standard QWERTY keyboard is *not* the most efficient typing arrangement, but as increasing numbers of people came to adopt it, it became the de facto standard.

We will see complex mixtures of these reasons when people give their motivations for adopting a technology. Returning for a moment to the case of direct-to-consumer genetic testing, why would anyone want to take part in such a thing, getting a readout of their genetic coding via a social media site? Well, because we can; because it is cool; because we want to be on the technological cutting-edge; because we fear disease and death and wish to control them; because we believe in patients' rights; because we wish to undermine all forms authority (in this case, medical expertise) based on status rather than truth. In other words, we can imagine a variety of reasons for wanting to use direct-to-consumer directing, ranging from the purely "personal" to the more purely "political." Yet, on this latter front, we should not be surprised that 23andMe, the best known of the DTC companies, is located in Silicon Valley and often uses the techno-libertarian rhetoric of attaining freedom and autonomy via the computer and the net.

Similarly, Susan Spellman (forthcoming) has described how small, family grocers adopted cash registers. Grocers had several potential reasons for wanting to purchase the technologies. First, registers could produce two kinds of efficiency. They could make book-keeping easier, and they allowed owners to survey their potentially thieving employees (the "hand in the till"). But reasons went well beyond these strictly "rational" ones. Grocery store proprietors could also flag their participation in technological and organizational modernity by displaying the registers, which were not always merely functional machines but could be fancy, gilded objects. Also, cash registers were not cheap, and storeowners could make claims to social status through the machines. Of course, there is also the possibility that some proprietors simply found the gadgets to be fascinating. As the genetic testing and grocery examples display, reasons for adoption are often multiple, and an individual adopter can have more than one reason in mind at any one time.

Scholars have also found that a good deal of consumption is "mediated," that representatives from corporations go out and show consumers how technologies could potentially fit into and improve their lives. As electricity companies came to worry about problems in their daily load of electricity generation (that businesses were consuming a great deal of electricity in the day but very few people were using it at night), they realized that they needed to foster increased electricity use at home. To do this, the firms went out and gave electric appliances to housewives. (Rose 1995) Similarly, gas and electric companies sent out people to give demonstrations on how to

cook with gas and electricity so that consumers would be more likely to adopt the technology. (Goldstein 2012)

The choices of adopters influence the choices of those that follow them. We have already seen this in David's analysis of QWERTY keyboards, wherein it became the de facto standard through increasing adoption. Other famous examples include the VHS-Betamax format war. The competition between VHS and Betamax demonstrates how complex the decision space can become since it was not simply about a relationship between producers and consumers but also about the perceptions of electronics stores and video rental shops. Economists often refer to these kinds of cases as "path dependence" or "lock-in" or as having "bandwagon" or "network effects." It is interesting that, in later work, David claims that de facto standards work like attractors, using a metaphor drawn from mathematics and physics. This notion of an attractor has strong resonances with Martin's account of field theory: overtime, the standard that is winning will seem to draw people in. The alternative, losing standard will seem increasingly unattractive. Choice space changes over time. Two years after Sony stopped making Betamax, it would be absurd to ask why someone bought a VHS player. Betamax became a punchline.

Technologies, Choices, and Strategic Action Fields

From here it is only a short step to the role technologies play in strategic action fields.¹⁰ In the previous section, I detailed several examples of why consumers in different kinds of strategic action fields adopted technologies. As Martin's description of field theory suggests, individuals and organizations adopt technologies based on what they are trying to accomplish, including anything from practical to symbolic goals. But there are some dynamics of technological adoption that open up once an actor or organization has entered a field, particularly when consciousness of others is an important part of those choices. An early thinker to recognize the place of technologies in social fields was Thorstein Veblen. With his notion of conspicuous consumption, Veblen realized that things (e.g. silverware, clothes, art) were bought and displayed as much for the status they symbolize as for their practical functions. There is likely a distinction to be made between people who choose to conspicuously consume items to peg themselves to a reference group and those who do so because they are seeking status in a field in a locality or organization. Individuals and organizations also experience considerable social expectations on the part of others that will make adoption attractive. For instance, users report feeling the need to be constantly available via email, cellphone, and text message.

Corporations also look to peer organizations, especially other companies in their own sector, when adopting technologies. For this reason, efficiencies afforded by new technologies often experience the kinds of "punctuated equilibrium" that Schumpeter

¹⁰ There is a slim, infrequently discernible gray region between when individual or collective actions are simply making technologically-mediated choice simply for their own reasons and when they are making it because they are members of a strategic action field. For this reason, perhaps it is best to examine how people choose to adopt technologies, and how the shift is made from actor-internal reasons to field-centric ones. It can be hard for us to separate internal reasons from field ones. For instance, do I want this just because I want it? Or because people are going to think I am cool for having it? This difficulty may be particularly pronounced in individualist societies that decry conformism. Martin's defense of actor's accounts falls down when actors are self-deluded, and one thing people are often self-deluded about—or at least are willing to mislead others about—is when they are doing things solely because they want to and when they are doing things because they care what others think about them.

described in his early work. (The term “punctuated equilibrium” is not Schumpeter’s but the dynamic he describes is similar enough to the evolutionary idea.) If a company adopts a technology that gives it significant competitive edge—as long as that technology is not patented or protected in some other way, as through secrecy—competitors will also rush to adopt it, bringing the competitive advantage of the technology back down near zero because everyone will have the same equipment. Rosenberg (1982) has argued that firms adopt technologies largely based on expectations of how those technologies will perform in the future. MacKenzie (1996) has gone further, arguing for a kind of self-fulfilling prophecy in which certain technologies come to be seen as superior and are thus adopted; but, further still actually come to influence subsequent design (as in the case of Moore’s Law). To these two notions of expectations, we should also add that individuals and organizations also anticipate what *others* will be doing with technology, and given their anticipation, they either try to keep up or keep ahead. This brings us finally to the literature on “first movers” or “first adopters.” As Everett Rogers explained in *Diffusion of Innovations* (1962, but revised several times afterwards), the adoption of technologies is largely driven by price. But Rogers describes a kind of adopter, which he calls the “innovator,” who cares little about price and desires to be on the cutting-edge. Just as being a non-conformist is a stance that socially-aware actors can take in part because they understand how others might react to this stance, the perceptions of others are likely an important part of innovators considerations. There can be several perks of being a late mover. Innovators and early adopters choose technologies based on their expectations of where the technology is headed, but these expectations can be wrong, and innovators can be stuck with technologies, like a Betamax player or an Atari Jaguar video game system, that went nowhere. Here, too, the interpersonal dimensions of fields are important. Late adopters will watch others’ experiences with devices before making their own choices, but the time very late adopters buy in it will almost seem inevitable that one *must* have the technology (e.g. a cell phone, an email account, a car in non-urban America).

In this way, what often seems like a “technological imperative”—the belief that a technology will inevitably be adopted and used—really is an *interpersonal* imperative. Interpersonal imperatives, as I have described above, can have their origins in many different kinds of social concerns. Thus, if there is a technological imperative, social scientists should study it in precisely the same way they study any other social imperative. Field theory will enable scholars in technology studies to examine more broadly how technologies are taken up within movements, organizations, and other fields; when they do so, they also will be in a better position to join in the wider conversations of social science. The reverse is also true, and it is to this point, how field theorists could stand to learn from technology studies, that I turn in my final substantive section.

Fields, Rules, and Technological Change

Scholars in technology studies have shown for some time that technologies have complex relationships to politics (both big-P formal politics and small-p power relations), including the rules and regulations that exist in fields. As mentioned earlier, Langdon Winner argued that “artifacts have politics,” that is technologies themselves can have political qualities. Bernard Carlson (2001, pg. 28) inverted this assertion positing that “politics have artifacts.” He described how the entrepreneur Gardiner

Hubbard created the telephone system both to challenge the monopolistic telegraph industry, which he thought catered unfairly to elite New York businesses, and to fulfill his vision of the middle class, which he believed would use the telephone to meet its needs and strengthen its identity. Richard John (2010, pg. 408), who also writes about telecommunications, echoed Carlson—“politics have artifacts”—when he described how 19th century political norms and ideas, like anti-monopoly, structured and limited technological systems, including the size of networks. Usselman (2002) examined how firms responded to politics and the legal environment, especially patent law, by, for instance, creating early research and development programs. This way the firms did not have to rely on external inventors (and their patents) but could internalize innovation and make it more efficient and predictable. Russell (forthcoming) also explores the dynamic interplay between politics and technological change. In the 1920s and 1930s, private, progressive standards-making bodies, fitting the definition of a “governance unit,” idealized a democratic, non-governmental process for coordinating firm actions and technological systematization. In reality, of course, these standards groups always experienced considerable power asymmetries, and large, influential firms often set the rules. Meanwhile, firms standardized their own technologies to improve processes and fit the ideal of the day and lobbied the standards bodies to make sure that their proprietary standards became *the* consensus or de jure standard—a strategy that would thereby protect market share and raise barriers to entry, among other outcomes). All of these examples are interesting and important, and people working in field theory would do well to attend to them. Yet, these works do not in and of themselves show how technology studies have the potential to push field theory—and field theorists account of rules in fields—into new terrain. For that, we must focus on a different set of examples, namely ones where the very possibilities of rules have complex relationships with and are at least partially dependent upon the possibilities of technologies.

For the sake of clarity and simplicity, I suggest that technologies can play three roles in regulation, three roles that partly shape potential rules. First, scientists and engineers use technologies to figure out what underlies a perceived problem and what risks are. Second, they build systems and processes that comprise tests used to certify technologies and carry out enforcement efforts. Third, rules can take into account the possibilities and potentials of regulated technologies themselves—possibilities that often limit or structure the rules.

On the first point, the history of regulation is full of stories about how regulators and their allies came to understand fully what a risk was. For instance, after being asked by the Chamber of Commerce to look into the smog issue, which was damaging California crops, the chemist, Arie Haagen-Smit, used the same equipment he typically employed to do things like isolate the flavor compounds of pineapples to examine the chemical components of smog. What he found was that the chemicals forming smog largely came from automobiles, whereas everyone had earlier assumed that the problem was heavy industry. Haagen-Smit’s discovery played a crucial role in beginning the regulation of automotive air pollution in the US and the rest of the world. Similarly, a surgeon in Detroit, MI, became interested in the biological mechanisms of concussions, which were poorly understood at the time. The surgeon realized, however, that concussions involved force and he did not understand how to study force, so he contacted a mechanical engineering department. Together, the surgeon and a young mechanical engineer began a series of experiments, dropping cadavers down elevator shafts and hitting anaesthetized dogs over the head with hammers, that would

eventually form the basis of the regulatory science of automotive crash safety. The two men were some of the founding members of a new field of inquiry, impact biomechanics. Technologies play essential parts in both of these stories. On the one hand, Haagen-Smit's equipment was already well-established but he used it to new ends. On the other hand, the Detroit biomechanics researchers were using a new technology, the wire strain gage, which had only been invented a year or two before they began their experiments. The strain gage was originally developed to test materials like metal and concrete in industry, but the Detroit researchers affixed the strain gages to bone and found that the devices worked very well for their purposes. Detection also plays an important role in regulatory stories. Gorman (2001) has shown that regulators created tighter regulations on the petroleum industry after technologies went from being able to detect parts-per-thousand to being able to spot parts-per-million.

Quite often, the kinds of studies described in the last paragraph come to undergird the kinds of tests that regulators use to control technologies and their risks. For instance, once Haagen-Smit discovered what automotive emissions were creating photovoltaic smog, regulators had to set limits on how much of those chemicals each car could emit and then create a test to determine whether cars were working within those limits. Creating the test was a long and complicated process. Regulators attempted to create a driving-cycle (a series of idle periods, accelerations, cruises, and decelerations) that accurately modeled what the *average* driver did in a day. Technologies limited the possibilities of the tests. For instance, the dynamometer (the rollers upon which a stationary cars wheels spin during the tests) will slip if accelerations or decelerations are too swift, so these changes in velocity had to be controlled. (Interestingly, regulators also have to create proxy tests for when full-blown tests are too costly or time-consuming. For instance, when drivers go to have their car inspected, it is run through an emissions test that approximates the federal test procedure, but the full blown federal test procedure takes hours, so we use a proxy.)

In a similar way, regulators built frontal crash tests and other kinds of safety standards that used the scientific data from the impact biomechanics studies. The data taken from crushed cadavers and hammered dog skulls quite literally *shaped* the automobile as dashboards and other car parts were designed to reduce forces below the limits set through the body studies. One of the ways that the technological potentials of these tests interacts dynamically with the regulatory rules and with the technologies eventually designed to live up to those rules is through science and technology studies' standard narrative trope of contingency. The test designers made judgment calls; the tests could have been designed some other way. These differences have potential consequences. It's also the case that regulators find that the test is not giving them what they want. For instance, nearly all of the early dynamic auto safety tests in the United States were based on frontal crashes, but statistics showed that many people were dying in other kinds of accidents. So, in the early 1990s, regulators created a side-impact standard, and later, they developed a gun that shoots an instrumented dummy head at various structural elements in the car. These new tests have led automakers to put airbags in nearly every substantial structural element in the car. Fligstein and McAdam sometimes seem to suggest that the state and governance units can simply set whatever rules they like and then the actors in the field will follow those rules. But in reality, enforcing rules is complicated work. In terms of enforcement, government agencies also have strategies, or at least tactics, and they have to make choices on how to develop these capacities with always-limited resources, just as firms do. The choices they make

on how to enforce rules often has consequences for how tightly firms follow the rules. In this way, government agencies must sometimes be seen as another actor in the field that conducts its own strategies to reach its goals.

Finally, rules often take into account the possibilities of regulated technologies themselves. Some technologies, like asbestos and lead water pipes, are so dangerous that we simply ban them outright, but these are also cases where there are alternatives laying ready at hand. Liberal notions of governance usually forbid bans, except in the most extreme circumstances. Legislators and regulators craft laws and rules that try to push technologies in positive directions, but the regulated technologies have limits. The 1970 Clean Air Amendments set the toughest automotive air pollution standards in history, but it also contained a safety valve. If the automakers could show that they had made “good faith” efforts but that control technologies were still not “feasible,” they could petition to have the law’s enforcement date put off for a year. That is, the law recognized that there might be limits to the speed of development and technological change. Similarly, though auto safety standards in the US do not have these good faith and feasibility clauses, it has become a traditional practice of the federal auto safety agency to show that at least one technical solution to a regulatory test exists before making that test a national standard.

I have argued elsewhere that when we take into account the potentials of the regulatory technologies and the regulated technologies as well as the regulatory rules, we can begin to see what moves are open to actors. There is a dynamic interplay between rules, technologies, and the choices of actors. For instance, scholars have known for many years that regulations structure markets and thus create openings for different strategies. (See, for instance, Vietor 1994) But we do not have as rich an understanding of how these facts affect technological change. For example, when federal laws regulated automobile safety and automotive air pollution control, the automakers had to decide whether to buy in risk-mitigating technologies from external sources or to build their own research and development efforts around these technologies. General Motors saw economic possibilities in these technologies and built its own considerable R&D efforts, while Chrysler lacked the resources to follow suit and largely relied on GM for these technologies. The technological outcome was that GM’s catalytic converter dominated part of the air pollution control market and became an important marker for the technological state of the art.

It is *not* simply that technological potentials in these three domains—understanding, testing and enforcement, and technological change and design—limit the possible rules available to rule-makers. The opposite is also true. For instance, one way to handle technological risks would be to nationalize industries that make risky technologies. We could imagine this influencing technological outcomes in all kinds of ways. But for deep ideological and legal reasons, this option is not available in the United States and other liberal countries. In other words, field theorists have already learned how to examine and describe a great deal of regulatory politics, but their accounts will be enriched by taking into consideration the kinds of technological potentials I just outlined. To do this, they would do well to learn from technology studies.

Conclusion

In this essay, I have explained the significant points of overlap and mutual forms of learning that could take place between field theory and technology studies. I mean

these words to be notes toward a conversation between these two academic specialties. I believe this conversation could be a fruitful one. After outlining the most recent synthetic model of field theory in my first section, I showed how field theory and technology studies connect around studies of social movements, organizations, and professions in my second one. The third section described how one form of field theory, the one outlined by John Levi Martin, can help technology studies disconnect itself from the long-standing bramble known as technological determinism. Finally, in the fourth section, I gave one example, drawn from the study of regulation, of how technology studies can enrich field theoretic accounts. I believe that there are several other places where similar learning between the two fields can and should happen.

Field theory and technology studies can help each other overcome significant internal issues. First off, field theoretic accounts often treat technology as a “black box,” to use a common metaphor from technology studies. To black-box technology is to treat it like its functions are given rather than resulting from various social processes. Furthermore, technological adoption has significant influences on the kinds of stories that sociologists tell, but they often neglect this aspect in their studies. Field theorists should learn from technology studies. To show how the inverse is also true, allow me to take example from science, rather than technology, studies. Robert King Merton was perhaps *the* founder of American sociology of science. Merton came to the study of science because he was interested in explaining society, and he realized that, after the early modern period, science played an important role in it. Although he continued to focus on science throughout his career, he also wrote about a great many other things. Merton was interested in *society*. Unfortunately, academic specialization, or overspecialization if you prefer, has not left us many Mertons. Instead, academics tend to spend the majority of their careers working in one distinct corner of the academic universe, working on a small set of problems. I believe, however, that most academics share Merton’s interest in big questions; unfortunately, the conditions of professional specialization dissuade us from asking them. If sociologists see hope in field theory for bridging several academic fields and subfields, I dare also to hope that it can bring scholars in science and technology studies back to asking larger questions about society than they have been doing for the last thirty years. That would be a great thing.

Obviously, not everyone will support the thoughts put forward here. This essay will likely present some troubling results for historians in general. For instance, I am saying that, to the degree that consumer studies have largely been focused on advertisements and other kinds of prescriptive sources, they have so far missed and, for the most part, will unlikely to be able to reconstruct why the vast number of individuals have adopted the technologies that they had and have. To do this, we need access to adopters’ reasons, and as is well-known, we rarely find adopters’ reasons recorded in archival sources. Equally obviously, not everyone will find field theory appealing. Those that want theory to be “useful” will likely be frustrated because field theory does not fit the tool metaphor of theory easily. Rather, it attempts to provide the most accurate picture of social reality. Field theorists believe that it is a true fact that a great deal—perhaps even most—of collective social action is organized through and around fields. Fields are real. Similarly, those who have accepted the “postmodern” notion that we cannot ever hope to give any central, synthetic accounts of society will find field theory alienating. For example, in a recent programmatic work on business history, the historians Philip Scranton and Patrick Fridenson (2013) argue that we should stop “searching for a new dominant paradigm” because such searches are a fool’s errand. I

submit all of the above words to suggest that such calls *might* be premature, and that field theory provides an opportunity for a new interdisciplinary synthesis that can bridge the disciplines of social science, science & technology studies, history, and more.