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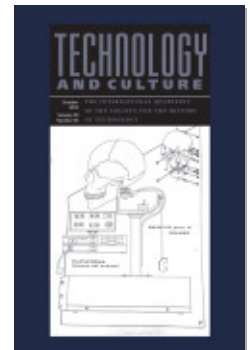
Millenarian Tinkering: The Puritan Roots of the Maker
Movement

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Technology and Culture, Volume 59, Number 4 Supplement, October 2018,
pp. S160-S182 (Article)

Published by Johns Hopkins University Press

DOI: <https://doi.org/10.1353/tech.2018.0153>



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Millenarian Tinkering

The Puritan Roots of the Maker Movement

FRED TURNER

ABSTRACT: Over the last ten years, technologists, pundits, and even President Obama have proposed that something called the “Maker movement” is transforming global manufacturing. But what exactly is this movement? Where did it come from? And what kind of world do its leaders want us to make? This paper examines a half dozen of the movement’s foundational texts in order to surface their visions of a good society. It then traces the roots of those visions back to MIT and the San Francisco Bay Area tech world, and through them, to deep streams of early American thought. In light of this history, the paper argues that the Maker movement is not simply a digital-technology-driven, bottom-up call for technological empowerment as its promoters claim. Rather, it represents a powerful, concerted effort by communities of engineers to knit their own professional imaginaries into the fabric of American myth. As such, the paper concludes, it also represents an especially useful site at which to study the ways in which digital technologies have become vehicles for conserving and exporting American culture.

On 18 June 2014, President Obama stepped up to a microphone in front of a White House briefing room full of high school students, engineers, and government officials, all contributors to the first ever White House Maker Faire. He was about to declare the day A National Day of Making. “Before I begin,” he said, “I have to ask: What on earth have you done to my house?”

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0040-165X/18/590X-0006/S160–S182

There's a mobile factory on the south lawn, there's a robotic giraffe, there's a giant red weather balloon in the rose garden, there's a paper craft dinosaur head in the hallway. Over here is a 3D-printed sculpture of my state of the union address . . ." The audience laughed, but not without a little pride: They had transformed the pre-eminent architectural emblem of America's past into a prototype of what they hoped would be its industrial future. And the President was on board. "Today's DIY is tomorrow's 'Made in America,'" said Obama. "Your projects are examples of a revolution that's taking place in American manufacturing, a revolution that can help us create new jobs and industries for decades to come."¹

If there were some cynical business reporters in the room, they could have been forgiven for scratching their heads: Just how exactly did a paper craft dinosaur head signal an industrial revolution? But they would have been in the minority—at the White House that day and in many corners of American business, academe, and popular culture too. Over the last decade, a wide array of technologists, journalists, and politicians have argued that the future of manufacturing lies in individual creativity. New technologies such as 3D printers and Arduino microcontrollers have made it possible for individuals to design and build new things and to drop them into the slipstream of global manufacturing, say the pundits. People need only find their way to places offering access to the new machines. There these technologies will spark long-forgotten passions. The people who use them will reimagine themselves as creators, as entrepreneurs, as innovators in the mold of Elon Musk and Steve Jobs. As they turn their dreams into things, they will become new people, whom spokesmen call "Makers." And with other, like-minded souls, they will become part of something whose name suggests that it has little to do with capitalism at all, the "Maker movement." In recent years, the language of "making" has even gone global. So-called "Makerspaces" have appeared in forty countries and Maker Faires have taken place in forty-two.² Foreign leaders too have embraced the Maker ethos. From India to China to Great Britain, politicians have celebrated individual creativity and individualized manufacturing as engines of economic and social improvement.³

But how did this happen? How did the timeless activities of tinkering, fixing, crafting, and constructing come to huddle under the umbrella term of "making"? And how did idiosyncratic, often ad hoc craftwork come to seem so central to the future of American and even global industrial manufacturing that President Obama could proclaim it revolutionary?

1. Barack Obama, "Remarks at the First Ever White House Maker Faire."

2. For a list of Makerspaces, see <http://spaces.makerspace.com/makerspace-directory> (accessed 8 February 2016). See also Gui Cavalcanti, "Is It a Hackerspace." For a list of Maker Faires, see <http://makerfaire.com/> (accessed 8 February 2016).

3. Silvia Margot Lindtner, "Cultivating Creative China"; Lindtner, "Hacking with Chinese Characteristics"; Lilly Irani, "Hackathons."

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FIG. 1 Dale Dougherty speaking at The Aspen Ideas Festival, 9 July 2010. (Source: Image courtesy of The Aspen Institute. Creative Commons License: Some rights reserved.)

To answer these questions, this essay turns to the writings of a half dozen of the movement's most visible promoters. They include Dale Dougherty, the publisher of *Make: magazine* and the person widely credited with giving the "Maker movement" its name; Neil Gershenfeld, an MIT professor; writers Corey Doctorow and Chris Anderson; and entrepreneurs Mark Hatch and David Lang. Individually and together, these six figures have built what we might think of as an ideological archipelago. They have created a series of events, organizations, talks, blog posts, articles, and books, each appearing to be an independent island of insight but all together interlinked by a steady traffic in overlapping stories. They have delivered TED talks, written for *Make: magazine*, built Makerspaces and founded companies connected to the movement they helped name. They are not alone, of course—advocates for the Maker movement can now be found around the world. Yet, it is hard to think of six figures whose works have been more widely cited or who have served as more visible figureheads for the movement. At every turn, they have proclaimed that new technologies have made individual creativity the potential basis for a new future for American industry, American workers, and America itself (fig. 1).

Paradoxically, they have done so in large part by re-animating the cultural and literary forms of the early American past. The theology of seventeenth-century American Puritanism is long gone, of course, but its literary forms and millenarian orientation suffuse the writings of the Maker movement's key promoters. One after another, they tell tales of a barren American landscape in which lonely individuals seek spiritual transformation. The angry God of Puritan America has been replaced by the awful winds of economic change. The Puritan's spiritual search for God's grace inside oneself has been replaced by the displaced worker's search for signs of the spirit of entrepreneurship, creativity. Like seventeenth-century ministers, these authors instruct us that spiritual transformation remains the only way to find a place in a world we can't control. And if we do it right,

they suggest, we will find ourselves surrounded by creative, self-actualized people like ourselves, and quite possibly great wealth.⁴

The promoters of the Maker movement are hardly Puritans, of course. They may not be religious at all. They may also be entirely unaware of the genealogy behind the cultural forms they have deployed. In part for these reasons, their writings prompt a second set of questions with deep roots in the history of technology. As David Noble has pointed out, Americans have long associated technological change with the hope for collective salvation.⁵ And as Max Weber famously showed, American capitalism has long labored in service of a Protestant ethic.⁶ Studying the promoters of the Maker movement offers us a chance to ask why. Like salesmen for the airplane or the telegraph, the promoters of the Maker movement have consistently argued that new technologies are *disrupting* the flow of history. Making is a radically new form of manufacturing, they claim; now that 3D printers are here, things will never be the same. Their claims beg a series of questions that have long lingered behind millenarian claims for new American technologies: Why would those who promote radical technological and economic disruption do so in such a way as to foster maximum cultural continuity? And why should citizens of an ever-more secular time invoke specifically religious cultural forms?

Finally, to study the promoters of the Maker movement is to look at technological change through the other end of the historian's traditional analytical telescope. Even as we ask how technologists invoke the past to sell their visions of the present, we can also begin to recognize that invocation as a key process by which our culture retains its coherence in the face of large-scale historical changes.

Story Brokers

In order to see how this process works, we need to first tease out three historical threads from the fabric of the Maker story writ large: the dissolution of economic security; the rise of new devices and new platforms; and the persistence of craft. As any number of commentators has explained, the relatively secure world of the Organization Man disappeared long ago. In its place, workers across an array of industries have found themselves moving from job to job, cobbling together several part time jobs, or be-

4. As Max Weber pointed out in *The Protestant Ethic and the Spirit of Capitalism*, the notion that those whom God has chosen for salvation may be marked by great wealth on earth has its roots in the Puritan doctrine of predestination. Even so, its deployment today echoes the ideals of other, more recent Protestant movements, and especially those of the prosperity gospel. See Simon Coleman, *The Globalisation of Charismatic Christianity*.

5. David F. Noble, *The Religion of Technology*; see also Morgan G. Ames, Daniela K. Rosner, and Ingrid Erickson, "Worship, Faith, and Evangelism."

6. Weber, *The Protestant Ethic and The Spirit of Capitalism*.

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coming unemployed all together.⁷ Inequality has widened and in America at least, the middle class has begun to melt away. The kind of precariousness that has always afflicted the working class now afflicts workers across all classes. Between 2007 and 2009, the Great Recession put these forces into stark relief. As the housing and financial markets collapsed in the United States, more than 7.5 million jobs vanished from the economy. In two years the unemployment rate rose from 4.4 to 10.1 percent. And by 2010, more than 40 percent of the long-term unemployed had been seeking work for more than six months. During those same years, the bottom 60 percent of American earners saw their incomes decline, while those at the very top saw theirs rise.⁸ The years after the recession have seen a very slow return to near-pre-recession employment levels, but only that.

At the same time, however, digital media have helped to drive two important technological changes. The first is a reduction in the size and cost of manufacturing technologies. As virtually all Maker advocates note, laser cutters, 3D printers, and the like became small enough and cheap enough in the early 2000s that middle-class consumers and hobbyists could buy and use them. The second important change is the rise of networked computer platforms. Even as new devices have individuated the manufacturing process, new online forums and new open source rights schemes have helped create pools of plans and communities of experts on whom individual manufacturers could draw. Finally, ever-more-capable global transportation and logistics networks have meant that individuals could have their homemade prototypes manufactured almost immediately in great numbers by distant factories.

In the United States, these economic and technological changes took place in a culture permeated with a do-it-yourself attitude. Rap, hip-hop, punk rock, zines, yarn bombing, poetry slams—since the 1960s, American youth culture has been preoccupied with rebellious, often craft-based forms of individual expression. Other Americans too have long traditions of quilting, knitting, cooking, hobby craft, woodworking, radio tinkering—the list is almost endless. Spokesmen for the Maker movement have claimed that new manufacturing technologies have driven a rise in DIY craftwork in America. But as they also note, craft has always been a part of American culture. This has been true in the realm of high technology as well. Before the Maker movement found its name, DIY scientists were experimenting with biology, hardware hackers were rewiring computers, and software hackers were rewriting code. As a number of writers have shown,

7. For a comprehensive analysis of how this process has played out in the United States since 1970, see Arne L. Kalleberg, *Good Jobs, Bad Jobs*. For a rich ethnographic account of how new economic structures are shaping the lives of newly mobile workers, see Ilana Gershon, *Down and Out in the New Economy*.

8. All figures from David B. Grusky, Bruce Western, and Christopher Wimer, “The Consequences of the Great Recession” 4, 13.

the American craft and DIY technology communities were strong long before the Maker movement came into being.⁹

In their writings, the promoters of the Maker movement have managed to entwine these three historical trends and to tie them to both the specific technologies they hope to promote and to a much older set of American stories. At one level, as Daniela Rosner and Jonathan Bean have argued, they have simply branded a set of long-standing cultural practices.¹⁰ They have thus created new markets for magazines, Makerspaces, laser cutters, and the like. Yet, they have also invoked the ghosts of American history. Though each has wares to sell, none speaks in the language of the marketplace alone. Rather, each writer has found a way to broker an encounter between emerging modes of manufacturing, the contemporary rhetoric of sales, and some of the oldest forms of American narrative.

To see how, we need only revisit two historical moments that loom especially large in the history of the Maker movement as described by its promoters: the creation of the first Fabrication (or “Fab”) Lab at MIT and the founding of *Make*: magazine in California. Neil Gershenfeld recounts the founding of the first Fab Lab in his 2005 book, *Fab: The Coming Revolution on Your Desktop—From Personal Computers To Personal Fabrication*. Gershenfeld is a physicist and a professor at MIT. In 1998, he taught a class entitled “How To Make (almost) Anything.” As he tells it in *Fab*, he and a team of MIT colleagues were interested in developing something like a *Star Trek* replicator, a programmable machine that could manufacture other machines, all on its own.¹¹ He gathered up a set of tools, advertised the course, and marveled as about a hundred students showed up for what was meant to be a class for ten.

According to Gershenfeld, the students displayed a peculiarly intense desire to get into the class. They were driven not by intellectual curiosity or careerism, but by a desire to make products that they had always wanted but had been unable to acquire. These ranged from a new kind of alarm clock to a portable device for capturing and replaying screams. The key point from Gershenfeld’s perspective was that “their inspiration wasn’t professional; it was personal. Their goal was not to publish a paper, or file a patent, or market a product. Rather, their motivation was their own pleasure in making and using their inventions.”¹² The pursuit of that pleasure in turn led students to do three things, writes Gershenfeld: learn how to use new manufacturing tools, teach others how to do the same, and find a way to bring a manufacturing process under their own command.

Gershenfeld’s class inspired the National Science Foundation to help

9. See Daniela Rosner and Sarah E. Fox. “Legacies of Craft”; David Gauntlett, *Making Is Connecting*; Amy Spencer, *DIY*.

10. Jonathan Bean and Daniela Rosner, “Making.”

11. Neil A. Gershenfeld, *Fab*, 4–8.

12. *Ibid.*, 6.

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sponsor a new center at MIT for micro-scale manufacturing, the Center for Bits and Atoms, and through it the building of five new versions of his classroom, now called “fab labs,” around the world. In 2002 the Center helped establish fab labs in inner-city Boston, rural India, Costa Rica, Norway, and Ghana. Locals turned the \$20,000-worth of equipment inside each lab to varied ends—making animal tags in Norway, blocks for printing textiles in India, marketable jewelry in Boston. In the years since, fab labs have been established on every continent save Antarctica.¹³

On its face, the global spread of fab labs looks to be nothing more than another tale of technological diffusion. Yet as Gershenfeld tells it, the process takes on a millenarian caste. Consider his account of the cosmos: “The universe is literally as well as metaphorically a computer,” he explains. “Atoms, molecules, bacteria, and billiard balls can all store and transform information.” The notion that the world is a computer was the guiding insight of cybernetics, of course, an intellectual movement that dominated cold war information theory and much of cold war social science, at MIT and beyond.¹⁴ As a technical discipline, cybernetics helped spawn innovations across technologies from computers to prosthetics. As an intellectual paradigm, it legitimated the rise of scientists and technocrats to positions of exceptional political influence.

In Gershenfeld’s book, it becomes a means to turn the digital technologies of the fab labs into tools with which to access the cosmic powers of the universe. Gershenfeld argues that the rise of small-scale manufacturing parallels the rise of personal computing. Early information theory spawned massive computing machines, he writes. As those machines became smaller, new applications drove their spread until micro computing had become ubiquitous. Today’s laser cutters are like yesterday’s mega-computers, room-filling and clumsy. But individuals’ desires to make things will cause those machines to shrink in size and cost. When they do, claims Gershenfeld, they will grant everyday users the kind of clear-eyed vision once reserved for cybernetic experts: now they too will see that the universe really is a giant information system. They will learn that the material world, the natural world, and digital software are all equally programmable. The ribosome is nothing more than a way of programming our own reproduction, writes Gershenfeld. We human beings are in essence self-replicating machines. Within a fab lab, he suggests, we might begin to internalize that knowledge in such a way as to take on the god-like power to make even life itself. “At MIT we have a joke that we now take seriously,” writes Gershenfeld. “A student working on this [3D-printing] project can graduate when their thesis can walk out of the printer.”¹⁵

13. For an up to date list of fab labs around the world, see Fabwiki.

14. Steve J. Heims, *The Cybernetics Group*; Geof Bowker, “How to Be Universal”; Paul N. Edwards, *The Closed World*; Andrew Pickering, *The Cybernetic Brain*; Ronald R. Kline, *The Cybernetics Moment*.

15. Gershenfeld, *Fab*, 238–41.

As a piece of writing, *Fab* displays many of the characteristics of a Puritan tract: it rewrites great swathes of human history; it tells exemplary tales of individuals touched by a kind of distant grace; and it maps a universe run according to ineffable principles. It also suggests that those marked for success in this world—here, scientists—have been blessed with a unique internal spirit—here, a passion for creativity. To find out whether they have been similarly gifted, ordinary citizens need only take up the tools on offer. Within the fab lab as Gershenfeld describes it, new technologies enable men and women to experience their own creativity. By expressing it on site, they form a sort of congregation of the saved. By discovering the grace of creativity inside themselves, they literally feel the power of the universe in their hands; by making something, they act almost divinely. And as Gershenfeld describes building fab labs overseas, it's hard not to hear echoes of the proselytizing that drove European expansion in centuries past. In his book, the formerly colonized peoples of India and Africa and the descendants of American slaves in Boston receive gifts of advanced technology gratefully. They too find inner passions. They too tap formerly hidden wells of creativity. And ultimately, they too begin to see them as possible keys to their economic and psychological salvation here on earth.

Gershenfeld need not have invoked this religious idiom. He could just as easily have told the story of the creation and diffusion of fab labs in, say, the lightly hyped style of a business journalist. Instead, he has inserted himself between the facts of the high-tech present and the millenarian dreams of Americans past. Within his book, what unites the two worlds is individual creativity. In the Puritan accounts of the seventeenth and eighteenth centuries, and in many more diversely Protestant accounts that followed, individuals discover God's grace within themselves and so can begin to build a New Eden here on earth.¹⁶ In Gershenfeld's account, it is the discovery of a passion to create that drives the potential transformation of the world. The aims of that passion have shifted. Gershenfeld and his students aim their creativity primarily at designing new and potentially marketable goods in a way that no Puritan would recognize. But the shape of the Puritan passion remains: it is the spiritual life of the individual on which the future depends (fig. 2).

In the same year that Gershenfeld published *Fab*, O'Reilly Media began to publish *Make*: magazine, with Dale Dougherty as its editor. Dougherty began his career as an editor of technical books and worked for many years

16. The most well-known statement of this view is John Winthrop's 1630 sermon, "A Modell [*sic*] of *Christian* Charity," which he delivered to a congregation of Puritans sailing toward the New World. "The way to avoid shipwreck" he wrote, was "to do justly, to love mercy, to walk humbly with our God." By thus following the "lawe of grace" within their individual souls, Winthrop's pilgrims would be able to collectively establish a New Jerusalem in New England, the famous "city upon a hill." See Winthrop, "A Modell [*sic*] of *Christian* Charity." For an introduction to the rich secondary literature on this issue, see Nelson R. Burr, "New Eden & New Babylon."

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FIG. 2 The Cover of the First Issue of *Make:* magazine. (Source: Image courtesy of Maker Media, Inc.)

under Tim O’Reilly. Ultimately, he would take *Make:* independent, but before he did, Dougherty borrowed a set of promotional tactics from his boss. O’Reilly Media has long been one of America’s leading publishers of computer how-to books. Yet as O’Reilly himself put it, “We didn’t . . . sell books; we sold a movement.”¹⁷ O’Reilly and his team created branded con-

17. Tim O’Reilly qtd. in Elizabeth Corcoran, “Making Future Headlines.”

ferences where computer people could meet and where O'Reilly could spot the latest trends.¹⁸ Over time, O'Reilly became one of the most visible intellectual arbitrageurs in Northern California and his company, one of the most influential in the American technology world. Dougherty adopted many of O'Reilly's tactics. As *Forbes* reported in 2008, "Dougherty . . . started drawing connections between a different set of distant dots: the profusion of powerful, cheap electronics; a deft software hacking community; crafting as popularized by Martha Stewart; and the growing green-or-recycling-rage." As O'Reilly put it, "Dale had the genius to say 'These are part of the same movement.'"¹⁹

When the first issue of *Make*: appeared in 2005, it drew immediate and widespread interest. Over the next three years, the magazine saw its circulation leap from 60,000 to more than 125,000. The magazine's own surveys discovered that 90 percent of its readership was male, and 75 percent of readers were college educated, over 40 years old, and in possession of an annual income of more than \$100,000.²⁰ In 2006 Dougherty took a page from the O'Reilly playbook and created the first "Maker Faire" just south of San Francisco. Exhibitors there included nearly as many women as men, and many families attended as well.²¹ Within a few years, Faires could be found around the globe, some sponsored by the magazine, others independent.

Unlike the other five authors under discussion here, Dougherty has not written a book about Making. Instead he has issued a steady stream of articles, blogs, TED talks, and the like. In each, he promotes a vision of psychological change that he has detailed in a longer article entitled "The Maker Mindset." Written to promote the integration of Makerspaces into schools and libraries, the essay argues that everyone has within them a core of creativity. Because of this, he explains, "The origin of the Maker Movement is something quite personal: 'experimental play.'" In his view, individuals have within them the desire and the power to create. To bring it to life, they need to come into contact with tools that will trigger an awareness of this power and allow them to express it. Once they do, they will become Makers. Schools must host this process and reflect it. "The kind of change we seek in education is . . . the kind of change we seek in ourselves," writes Dougherty.²²

At one level, Dougherty's account is a carefully phrased marketing pitch: buy new manufacturing technologies and install them, he tells educators, and you will produce smart, creative students. At another though, it echoes long-forgotten calls from the pulpits of seventeenth-century New

18. Evgeny Morozov, "The Meme Hustler"; Fred Turner and Christine Larson, "Network Celebrity."

19. Corcoran, "Making Future Headlines."

20. Susan Currie Sivek, "We Need a Showing of All Hands," 191.

21. On-site observation by the author.

22. Dale Dougherty, "The Maker Mindset."

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England. Early American settlers believed that God had already decided which souls he would save and which he would damn. Fallen human beings could never know who was saved and who was not, yet they could search for signs of their own election. In the early American Puritan church, the key sign of potential salvation was the experience of God's grace.²³ After much wrestling with themselves, Puritans hoped to find a regenerative spirit within, a gift of grace from God that would sustain them in their travels across this fallen world. The early American Puritan congregation consisted solely of those who could testify to having had such an experience. In Dougherty's account, students too must find a new spirit inside themselves and with it, a new mindset. This spirit has been cut away from the theology of grace and attached instead to the individualistic ethos of contemporary capitalism. Students must now experience the gift of creativity. And the school must become a new congregation: a community organized around the tools and forms of structured play that ostensibly awaken that gift. Once they do, both students and schools will be sustained in the endeavors to come.

The work ahead consists of traveling through a fallen land of economic distress. In 2008 the American economy tumbled mightily, and in many corners of the country has hardly recovered. Dougherty himself rarely addresses broad economic issues, but most all other prominent Maker advocates place them front and center. Cory Doctorow's 2009 novel *Makers* paints an exceptionally rich portrait of America's post-2008 economic landscape. Doctorow is a prolific science fiction writer who is perhaps best known for co-editing one of the world's most influential technology blogs, *BoingBoing*. Though he lives in Los Angeles, he has written regularly for *Make*: magazine and has been a central figure in northern California technology circles for many years. In *Makers*, he turns individual creativity and small-scale manufacturing into engines of spiritual and economic renewal.

Doctorow's tale follows Suzanne, a reporter laid off from a Miami newspaper, who attaches herself to Perry and Lester, steampunk engineers who turn beach trash into toasters. When an entrepreneur named Kettlewell draws Perry and Lester into a globally networked, for-profit manufacturing collective, Suzanne chronicles their adventures. Kettlewell explains their situation thus:

Capitalism is eating itself. The market works, and when it works, it modifies or obsolesces everything. That's not to say there's no money out there to be had, but the money won't come from a single, monolithic product line. . . . Our business plan is simple: we will hire the smartest people we can find and put them in small teams. They will go into the field with funding and communications infrastructure. . . . Our company is . . . a *network* of like-minded, cooperating

23. Edmund S. Morgan, *Visible Saints*, 64–112.

autonomous teams, all of which are empowered to do whatever they want, provided that it returns something to our coffers. We will explore and exhaust the realm of commercial opportunities, and seek constantly to refine our tactics to mine those opportunities, and the krill will strain through our mighty maw and fill our hungry belly. This company isn't a company anymore: this company is a network, an approach, a sensibility.²⁴

Perry and Lester establish their node on the company network in a run-down corner of Florida, with Suzanne by their side. They build what Neil Gershenfeld would call a fab lab, or what O'Reilly Media might call a Makerspace—a small scale factory equipped with scanners, laser cutters, 3D printers, and other “rapid prototyping machines.”²⁵ For these heroes of Doctorow's novel, small-scale manufacturing opens doors to individual economic independence and psychological security, and even the chance to eliminate the inequities of capitalism. Their factory lies just down the road from a homeless encampment. Soon Perry and Lester and the homeless begin collaborating, “inventing and remixing new techniques for building cheap and homey shelter fast.”²⁶ Together they build a workshop in an abandoned shopping mall. They become emblems of what Perry calls “the New Work industry,” a mode of manufacturing in which, as Lester puts it, “micro-entrepreneurs [are] solving post-industrial problems.”²⁷

In *Makers*, Lester and Perry become models of what Gershenfeld suggests that the global recipients of fab labs can aspire to: psychological and economic independence and a comfortable home in the global economy. They even hang a sign over the workshop door: “AUTHOR OF YOUR OWN DESTINY.” In the second half of the book, Kettlewell's company fails. Rather than return to a nine-to-five job in a company with benefits and perhaps a pension, Lester and Perry double down on their individual creativity. They build a theme park out of all the idiosyncratic devices they and their pals have made. They release the designs for their rides as if it were open source code and marvel as other idiosyncratic engineers make theme parks of their own around the globe. Each park keeps its own funds, but together they constitute something like the networked firm that Kettlewell imagined in the first place. Only now, instead of being governed by corporate charters and airplane-hopping managers, these new profit centers collaborate across lines of shared tastes and interpersonal connections.

To readers weaned on Uber and Facebook, Doctorow's account must look thoroughly contemporary. But if we scrape away the rhetoric of open source networking and rapid prototyping, we can see the outlines of an-

24. Cory Doctorow, *Makers*, 11.

25. *Ibid.*, 93. For a review of the term “Makerspace” and common alternatives, see Cavalcanti, “Is it a Hackerspace.”

26. Doctorow, *Makers*, 84

27. *Ibid.*, 106–8.

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cient allegories such as John Bunyan's seventeenth-century classic *The Pilgrim's Progress*. Lester and Perry are modern versions of Bunyan's everyman, Christian. Like him, they must leave the failures of this world behind if they are to reach the next. In Christian's case, the failures are the consequence of sin; in Lester and Perry's, they are the consequence of economic and technological change. And in Christian's case, the next world is heaven, while in Lester and Perry's, it is simply a place in the networked economy. In both accounts, the trials and tribulations the heroes endure drive them to spiritual transformation. Christian discovers God's grace; Lester and Perry find their own creativity. All three inhabit a world of fallen souls and all three are saved.

"You Could Be The Next Elon Musk"

Doctorow's novel is hardly a religious tract, of course. Doctorow's readers would probably be as baffled by the early American Puritans as the Puritans would be by the sharing economy. Yet both communities have oriented themselves around a visible elect. This becomes especially clear in the three books most closely tied to the San Francisco Bay area Maker scene: Chris Anderson's nonfiction chronicle *Makers* (2012), David Lang's autobiographical *From Zero to Maker* (2013), and Mark Hatch's *The Maker Movement Manifesto* (2014). Each of these volumes argues that small-scale manufacturing of the kind carried out in fab labs foreshadows the rise of a new economic paradigm. For now, that paradigm lingers like heaven in the distance. Contemporary workers languish in a landscape of low wages, repeated unemployment, and constant deskilling. If they are to reach the kind of independence that characterizes the lives of Doctorow's Perry and Lester, they are going to need to undergo a conversion. They must transform themselves from victims of the post-industrial economy to its masters. They must turn themselves into Makers.

But what exactly does that mean?

The first step, according to all three authors, is to recognize the fallen condition of the contemporary economic environment. Fortunately, new technologies will lift us out of the mud. All three agree: The industrial world is on the edge of what former *Wired* magazine editor and Berkeley-based journalist Chris Anderson calls a "Third Industrial Revolution."²⁸ Individuals and small firms rather than large corporations now drive innovation and economic growth, claims Anderson. Though he remains vague about which industries exhibit this pattern and how much they've grown from it, Anderson is remarkably clear about where this pattern got its start. Just as the counterculture brought us *The Whole Earth Catalog* and the Homebrew Computer Club, and through them, Steve Jobs and Apple

28. Chris Anderson, *Makers*, 41.

Computer, he argues, so now the Maker movement is “using 21st-century tools to try to effect the same sort of revolutionary social and economic change.”²⁹ In Anderson’s view, every person who walks into a Makerspace is a potential Steve Jobs or Stewart Brand. “The idea of the factory is changing,” he writes. “Just as the web democratized innovation in bits, a new class of ‘rapid prototyping’ technologies . . . is democratizing innovation. You think the last two decades were amazing? Just wait.”³⁰

If Anderson were an economist, he might have urged his readers to think of themselves as workers and to develop new skill sets. Instead, he urges them to imagine themselves as members of a social movement. This move in turn opens small-scale manufacturing to a much grander symbolic landscape, a region planted with Puritan tales of self-discovery. To become a successful Maker requires reforming one’s inner life. Mark Hatch, the CEO and co-founder of TechShop, a for-profit Makerspace chain, puts it this way: “Participating in the Maker Movement is a personal journey. . . . No two paths will be the same. But you will change. You’ll begin to see the world through the eyes of someone who participates in creating.”

Your inner reformation may well change your class status too. Joining the Movement “will open up your life to the highest concentration of creative people in your community,” Hatch explains.³¹ As you change, you will climb your way up the ladder of creativity and perhaps become an industrial titan yourself. “Just because you are not an industry player doesn’t rule you out,” writes Hatch. “The rules for success in the twenty-first century are emerging, and they are radically different from the rules in the nineteenth and twentieth centuries. . . . If you are will to climb the knowledge ladder needed, maybe you, too, could become the next Elon Musk.”³² And don’t worry: getting started requires no training, no special expertise. Simply go to a Makerspace, sign up for a class, and start working a tool. Within twelve weeks, writes Hatch, you may well have gone “through your own personal maker revolution.”³³

Hatch’s rhetoric will be familiar to anyone who watches late-night infomercials. You need only buy the product, try it for a few short weeks, and you too will become as rich and handsome as the people on TV. But the obsession with self-improvement in the face of economic adversity that threads through his book also reflects the logic of Puritan conversion. Now, as then, readers must imagine themselves as the suffering citizens of a turbulent landscape. In the seventeenth century, such citizens would have been blind to the presence of God’s grace within themselves. In the twenty-first, they are blind to the powers of creativity that animate both their inte-

29. *Ibid.*, 23.

30. *Ibid.*, 16.

31. Mark Hatch, *The Maker Movement Manifesto*, 31.

32. *Ibid.*, 145.

33. *Ibid.*, 80.

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rior lives as a form of grace, and the economy as a mode of profit. In both cases, they must undergo a rigorous self-examination in the company of like-minded others. To become a fully-fledged member of a seventeenth-century New England church, a person would need to discover and experience God's grace within, and then report that experience to the congregation as a whole. Grace itself was a gift from God, an overflowing of His love for human beings; to work in the Puritan soul, it needed to be shared.

Individual Puritans' reports took a generic form we now call the "conversion narrative."³⁴ Today, the promoters of the Maker movement tell similarly confessional tales of economic collapse, spiritual malaise, and salvation through technology. David Lang pens one of the most comprehensive and widely cited such stories in his memoir-cum-advice-manual, *From Zero to Maker* (fig. 3):

It all started one June morning . . . in a small office in Los Angeles. . . . As a startup, we were struggling; revenue trickled to a halt, investors were backing away, and the attitude around the office was bleak. The plan was to meet at nine AM for a team meeting and strategy session. When the founders of the company arrived late and asked only me to come into the conference room, I knew it wasn't going to be good news.

They were letting me go.

Just like the headlines I have seen for the past two years—more layoffs, jobs eliminated, and record unemployment—but delivered with a piercing stab. It was no longer happening around me; it was my new reality. . . . I couldn't help but think back on the events that led up to this moment, trying to excavate some sign I overlooked in the haze of unshakable confidence in being on the right path: a good college education, strategic work experience, and a job with a promising young startup company. . . . I felt that in this work shakeup, my life story had been stripped away from me. My personal narrative—my sense of purpose and direction in the world—no longer made sense.³⁵

Lang's account fairly aches with a sense of betrayal. He had trusted in schools and in his company; they had abandoned him. He was a failure, a zero. Like the hero of *A Pilgrim's Progress*, Lang finds that he has stumbled into a what Bunyan famously called a "slough of despond." How could he explain what happened? And how could he pull himself up? Like the hero of Bunyan's allegory, he discovers that he cannot answer either question by

34. See Patricia Caldwell, *The Puritan Conversion Narrative*. The conversion narrative played a particular role in Puritan life, but its generalized form can be found throughout Christian cultures. Simply consider the ubiquity of the phrase "I was blind and now I see . . ."

35. David Lang and Rebecca Demarest, *Zero to Maker*, 7.



FIG. 3 Cover of David Lang's Maker autobiography. (Source: Image courtesy of Maker Media, Inc.)

thought alone. Rather, he must turn inward. He must give himself over to spiritual self-examination, and thereby open himself to receiving help from without. When Lang attends a Maker Faire near San Francisco, he experiences a revelation:

I realized how tragically specialized I had become. I was extremely well prepared for a job that no longer existed, without the fundamental skills I could repurpose elsewhere. I seem to be far away from being able to come to build, fix, or create anything of tangible value—any real, physical thing. My so-called skills—emails, social media, and blogging—were hollow substitutes. Now, after hurtling in and out of a digital career, I felt as though I were missing a critical piece of my humanity.³⁶

36. Ibid., 8.

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There is a deep irony here. Lang has been expelled from employment by the structural forces of high-tech capitalism and more specifically, by his company's failure to make a product that sells. Lang internalizes that failure, berating himself for being unable to make a useful product on his own. But rather than confront the structural forces shaping his life as structural forces, and rather than try to take any sort of collective action, Lang takes the structures of capitalism inside himself. He actually decides to *become* that which hurt him. He will transform himself into a company of one, an individual manufacturer. He will turn away from the world of intangibles, of the flow of bits and bytes and capital, and do the work those flows *should* have been doing to ensure his security himself.

When he does, Lang rediscovers a truth that Gershenfeld, Dougherty, Doctorow, Anderson, and Hatch hold to be self-evident: that the essence of individual happiness, of psychological and financial security, and of successful sociability lies inside the individual. Once known as grace, this inef-fable essence is now called creativity. It waits to be triggered by an encounter with digital technologies. Lang begins to take classes in three-dimensional printing and laser cutting and reads Gershenfeld's *Fab*. He gives himself a month to become a Maker and he convinces the editors of *Make*: magazine to host a blog called "Zero to Maker in 30 Days." Eventually, he finds his way to roboticist Eric Stackpole and together they develop a small, camera-equipped underwater robot. Today, he and Stackpole run a company selling kits to help others do the same. By the end of the book, Lang hasn't revealed whether he has achieved financial security. But he does say that he has "gone from nonexistent engineering or design experience to making substantial contributions to underwater robotics." And perhaps more importantly, "I had flipped the switch from being a passive consumer of life to an engaged, creative participant in it. I had gone from Zero to Maker."³⁷

Once awakened, Lang's creativity admits him to new congregations of the similarly inspired. Early on, Lang begins to build a network around his own desire for self-improvement. Much of that network is digital. He discovers online resources such as Sparkfun, Adafruit and Maker Shed—all web sites with how-to resources for electronics, as well as online communities such as OpenROV and DIY Drones, which deal with remotely operated vehicles. Within the TechShop where he works, he discovers that the work of building something requires assembling a team with whom to work. "Making," he explains, "was about the art of finding other people—seeking out teachers, creating adjoining like-minded groups, collaborating with strangers—and co-creating together."³⁸

Within a firm, such groups might be called product development teams. But here, Lang calls them a "community."³⁹ Like Gershenfeld and

37. *Ibid.*, 7.

38. *Ibid.*, 19.

39. *Ibid.*, 150.

Doctorow, Lang reimagines collaborative product development as an alternative mode of polity, with creativity at its center. Governmental politics may be bankrupt, the economy may be a series of hurricanes, but here in Makerspaces there lives a world organized around individual dreams and tools to help make them come true. The instrumental social relations of his former company seem to have melted away. In the Makerspace every member pursues his or her own project. They work together by choice and necessity, but they retain control of their lives. They may pay dues to a for-profit TechShop but profits come second: For Lang and other members it became a deeply democratic, highly individualistic, and yet collaborative alternative to ordinary society.

According to Lang, the turn to individual creativity him offered economic security as well. When he went to his first Maker Faire, Lang thought the people he saw there “had an approach to their work that nobody—not an employer or an angry customer or a turbulent economy—could take away from them.”⁴⁰ For Lang, what guarantees security is not market analysis or quality engineering; it’s one’s internal emotional condition. Like other Maker promoters, Lang offers up brief biographies of Makers who exemplify this condition and the wealth it can bring. Lang tells the tale of Lisa and Abe, who turn their DIY designs for a sous vide cooking machine into a multi-million-dollar company. Lang notes in passing that Abe has degrees from Cal Tech and Princeton and that Abe and Lisa have ties to a Silicon Valley innovation accelerator and to manufacturers in Shenzhen. But what drives their success, he says, is their “courage to follow their passion.”⁴¹ Though the rhetoric of courage and passion belongs to the contemporary world of marketing, its deployment follows a deeper historical pattern: Here, as in Bunyan’s time, it is the reformation of the inner life that makes living successfully in the outer world possible.

Even as Lang and his fellow authors proclaim the power of passion to produce wealth, they back away and suggest that what *really* matters isn’t money at all. It’s self-transformation. “The goal of re-skilling yourself doesn’t need to mean being an entrepreneur or building a business like Lisa and Abe,” writes Lang. “It’s also perfectly wonderful if making remains a hobby . . . or something you’re doing to help arm your kids with skills for the future. It’s all up to you.”⁴² Lang goes on to acknowledge that virtually all the Makers he meets sustain themselves with part-time jobs. The TechShop is a place to work on their dreams, their ideas. They *might* strike it rich like Lisa and Abe. Or they might just cultivate a “mind that is open to new ideas, new people, and new possibilities.”⁴³

On the surface, Lang’s argument appears to be an ordinary and com-

40. Ibid., 91.

41. Ibid., 137.

42. Ibid.

43. Ibid.

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pletely contemporary exercise in the hedging of bets. But his claims for the potential power of creativity to drive one's economic success also track the logic of the Puritan quest for signs of election. In seventeenth-century America, many believed that God would shower those whom he had selected for heaven in the afterlife with wealth here in this life. Yet all Puritans knew that such a belief could be only that, a belief. God's choices of whom to elect would always remain invisible to the fallen eyes of human beings. Thus, Puritan ministers reminded their flocks to focus on their inward lives, on the search for the experience of grace. Puritans could not know if they had been saved for sure; yet they could attend to the sensation of grace within and so keep their hopes up.

In Lang's account, this Puritan logic lurks silently below the rapid-fire voice of the late-night TV pitchman as he reads the small-print disclaimer at the bottom of the screen. It is true that Lisa and Abe built a company. It is true that Lang himself helped build a robot and a company around it. It is also true that their success is exceptional. In these books, financially successful entrepreneurs like Lisa and Abe are the bait in a classic bait-and-switch. You too could succeed, say the writers, just like these folks. So what if the odds are against you! Do you have the desire? The passion? Never mind those degrees from Cal Tech and Princeton. It's all about creativity in the end. And if you don't make a pile of money? Well, you'll at least you'll have found the creative part of your own soul. And you'll be a member of a community of like-minded creatives too. When the next opportunity comes around, you'll be ready.

Conclusion

In Lang's confessional, as in all the writings gathered here, creativity has become a secular form of Puritan grace. The chaotic American economy has replaced the spiritual wilderness of Puritan times with a new testing ground. The all-seeing, all-foreordaining God of the seventeenth century has disappeared into the all-pervading, future-deciding logic of the marketplace. To inhabit this new world effectively, these texts suggests, one must take up tools of spiritual regeneration and with others likewise marked by the signs of creativity, build new congregations of Makers, and with them a new America.

Here we can begin to glimpse the cultural logic by which President Obama could plausibly claim that a paper craft dinosaur head represents the future of American manufacturing. The notion that individual tinkers can provide the industrial muscle needed to employ millions of Americans, stave off global competition, and return America manufacturing to greatness is absurd. Yet, the promise that the forces of the global economy can be mastered through a species of technology-enabled spiritual exercise is enormously appealing. So too is the familiarity of that promise. By fram-

ing the Maker movement in centuries-old millenarian terms, the promoters of Making have made it possible to imagine that 3D printers and micro-controllers are not just new toys, but tools of spiritual transformation. Thus reframed, they are deeply American, and so entirely fit for display at the White House.

For historians of technology and culture, the Maker movement offers several potential lessons. The first concerns the legacy of Weber's Protestant ethic. In Weber's account, the Puritans' anxiety over the status of their election caused them to elevate the pursuit of profit to a calling. As they labored to accumulate wealth, they saw what wealth they piled up as a potential indicator of their salvation after death. The spokesmen of the Maker movement likewise promote tinkering as a calling that can lead to wealth, and even to membership in an entrepreneurial elect. Yet they have also turned important elements of the ethic Weber described on their heads. Weber stressed that the Protestant ethic generated a *rational and rationalized* pursuit of profit. The Protestant ethic lacked even a hint of hedonism, he wrote.⁴⁴ The Maker ethic by contrast stresses the importance of the irrational, the playful, the creative—first as sources of profit, and second as the bases of profitable organizations. The industrial bureaucracies of Weber's account have disappeared. Flexible, collaborative teams now dominate both Makerspaces and much mainstream manufacturing. In this new world, hedonism counts. To become properly creative, one must first feel a *passion*. Making channels that passion into profitable productivity. The Maker spokesmen have marbled the Protestant ethos with Romantic notions of the self as a free-standing individual, driven by winds of emotion from within. It is the tools themselves that provide the discipline, the structure, and context within which Makers can transform those impulses into the grace of creativity, and from there, perhaps, into manufacturing wealth.

The second lesson concerns the persistent utility of history in the marketplace. For the spokesmen of the Maker movement, linking the tools and spaces they hope to promote to the rich legacy of American culture turns their ambitions into delightfully new extensions to cultural projects so thoroughly accepted in American society as to be beneath notice. These extensions in turn invite users not simply to consume new goods, but to re-enter the narrative of American history from which economic forces may have excluded them. To buy their tools or work in their TechShops is to imitate the heroes of Silicon Valley not as actual industrialists, but as mythical figures. It is to insert oneself into an ongoing American story as a leading character.

Millenarian dreams have repeatedly surrounded new technologies, of course. And American Puritanism is hardly the only cultural formation to inform those dreams. Nineteenth-century Romanticism, twentieth-century universal humanism, the self-help cultures of both centuries—the

44. Weber, *The Protestant Ethic and the Spirit of Capitalism*, 53.

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chain of such cultural circles in American history is long and tangled. But this too gives historians something to think with. We are accustomed to being able to account for the power of history to the degree that we can make clear empirical links between the past and the present. Yet much of the power of the ties that the promoters of the Maker movement have established between early America and today derives precisely from their vagueness. If David Lang were to adopt the idiom of the Puritan conversion narrative full-blown, rather than merely borrow it in outline, his tale would become unintelligible to contemporary readers. By letting the shape of the conversion narrative hover in the background, a hazy, indistinct, yet familiar literary presence, Lang can reassure his reader. His tale may be new, but the cultural logic behind it is not.

Such a blurry entwining of the past and the present offers historians of technology and culture an opportunity. As the lives of the writers under discussion here suggest, millenarian ideals do not attach themselves to new devices. On the contrary, businessmen, intellectuals, and hucksters of all kinds step up and do the ideological work of tying the new to the old. They create umbrella terms such as “Maker,” vague enough to be widely adoptable, yet familiar enough to make sense. They write books and manifestos, and they send their writings out across multiple islands of intellectual intervention—blogs, conferences, online videos, and more. As their works travel, they become part of a common sense that is itself a blurring of the past, the present, and the particular futures hoped for by figures such as those reviewed here.

As historians trying to explain the persistence of millenarianism alongside emerging technologies, even under increasingly secular conditions, we must continue to scout for those promotional communities who have a stake in knitting past and future together. At the same time, as scholars who can recognize the historical ground on which such promoters paint figures of the futures they seek, we have a chance to speak to our contemporaries in a new way. Much of the appeal of Maker ideology depends on its ability to transform the pressures of economic and technological change into objects of individualized, spiritualized attention. By separating the economic and technological changes of our moment from the cultural forms of our history, we might offer our fellow citizens a chance to come to grips directly with the structural forces shaping their lives.

Bibliography

Ames, Morgan G., Daniela K. Rosner, and Ingrid Erickson. “Worship, Faith, and Evangelism: Religion as an Ideological Lens for Engineering Worlds.” In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing*, 69–81. New York: ACM Press, 2015.

- Anderson, Chris. *Makers: The New Industrial Revolution*. New York: Crown Business, 2012.
- Bean, Jonathan, and Daniela Rosner. "Making: Movement or Brand." *Interactions* (January-February 2014): 26–27.
- Bowker, Geof. "How to Be Universal: Some Cybernetic Strategies, 1943–1970." *Social Studies of Science* 23 (1993): 107–27.
- Burr, Nelson R. "New Eden & New Babylon: Religious Thoughts of American Authors: A Bibliography: Part II." *Historical Magazine of the Protestant Episcopal Church* 54, no. 2 (June 1985): 151–85.
- Caldwell, Patricia. *The Puritan Conversion Narrative: The Beginnings of American Expression*. Cambridge, UK: Cambridge University Press, 1983.
- Cavalcanti, Gui. "Is It a Hackerspace, Makerspace, Techshop, or Fablab?" *Make*. 22 May 2013. <http://makezine.com/2013/05/22/the-difference-between-hackerspaces-makerspaces-techshops-and-fablabs/> (accessed 10 February 2016).
- Coleman, Simon. *The Globalisation of Charismatic Christianity: Spreading the Gospel of Prosperity*. Cambridge, UK: Cambridge University Press, 2000.
- Corcoran, Elizabeth. "Making Future Headlines," *Forbes Online*. 13 August 2008. www.forbes.com/2008/08/13/diy-innovation-oreilly-tech-egang-08-cx_ec_0813oreilly.html (accessed 10 February 2016).
- Doctorow, Cory. *Makers*. New York: Tor, 2009.
- Dougherty, Dale. "The Maker Mindset." In *Design, Make, Play: Growing the Next Generation of Stem Innovators*, edited by Margaret Honey and David E. Kanter, 7–11. New York: Routledge, 2013.
- Edwards, Paul N. *The Closed World: Computers and the Politics of Discourse in Cold War America*. Cambridge, MA: MIT Press, 1996.
- Fabwiki. <http://wiki.fablab.is/wiki/Portal:Labs> (accessed 12 February 2016).
- Gauntlett, David. *Making Is Connecting: The Social Meaning of Creativity, from DIY and Knitting to YouTube and Web 2.0*. Cambridge, UK: Polity Press, 2011.
- Gershenfeld, Neil A. *Fab: The Coming Revolution on Your Desktop—from Personal Computers to Personal Fabrication*. New York: Basic Books, 2005.
- Gershon, Ilana. *Down and Out in the New Economy: How People Find (or Don't Find) Work Today*. Chicago: University of Chicago Press, 2017.
- Grusky, David B., Bruce Western, and Christopher Wimer. "The Consequences of the Great Recession." In *The Great Recession*, edited by David B. Grusky, Bruce Western, and Christopher Wimer, 3–20. New York: Russell Sage Foundation, 2011.
- Hatch, Mark. *The Maker Movement Manifesto: Rules for Innovation in the New World of Crafters, Hackers, and Tinkerers*. New York: McGraw-Hill Education, 2014.

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- Heims, Steve J. *The Cybernetics Group*. Cambridge, MA: MIT Press, 1991.
- Irani, Lilly. "Hackathons and the Making of Entrepreneurial Citizenship." *Science, Technology, & Human Values* 40, no. 5 (September 2015): 799–824.
- Kalleberg, Arne L. *Good Jobs, Bad Jobs: The Rise of Polarized and Precarious Employment Systems in the United States, 1970s to 2000s*. New York: Russell Sage Foundation, 2011.
- Kline, Ronald R. *The Cybernetics Moment, or, Why We Call Our Age the Information Age*. Baltimore: Johns Hopkins University Press, 2015.
- Lang, David, and Rebecca Demarest. *Zero to Maker: Learn (Just Enough) to Make (Just About) Anything*. 1st ed. Sebastopol, CA: Maker Media, 2013.
- Lindtner, Silvia Margot. "Cultivating Creative China: Making and Remaking Cities, Citizens, Work and Innovation." Ph.D. diss., University of California, Irvine, 2012.
- _____. "Hacking with Chinese Characteristics: The Promises of the Maker Movement against China's Manufacturing Culture." *Science, Technology, & Human Values* 40, no. 5 (September 2015): 854–79.
- Morgan, Edmund S. *Visible Saints: The History of a Puritan Idea*. New York: New York University Press, 1963.
- Morozov, Evgeny. "The Meme Hustler: Tim O'Reilly's Crazy Talk." *The Baffler*, no. 22 (March 2013): 66–67, 125–47.
- Noble, David F. *The Religion of Technology: The Divinity of Man and the Spirit of Invention*. New York: A. A. Knopf, 1997.
- Obama, Barack. "Remarks at the First Ever White House Maker Faire, June 18, 2014." Video by The Obama White House, 15:13. 18 June 2014. Available at www.youtube.com/watch?v=7wHorfRvvcE (accessed 14 September 2015).
- Pickering, Andrew. *The Cybernetic Brain: Sketches of Another Future*. Chicago: University of Chicago Press, 2009.
- Rosner, Daniela, and Sarah E. Fox. "Legacies of Craft and the Centrality of Failure in a Mother-Operated Hackerspace." *New Media and Society* 18, no. 4 (April 2016): 558–80.
- Sivek, Susan Currie. "We Need a Showing of All Hands': Technological Utopianism in *Make Magazine*." *Journal of Communication Inquiry* 35, no. 3 (2011): 187–209.
- Spencer, Amy. *DIY: The Rise of Lo-Fi Culture*. London: Marion Boyars, 2005.
- Turner, Fred, and Christine Larson. "Network Celebrity: Entrepreneurship and the New Public Intellectuals." *Public Culture* 27, no. 1 (2015): 53–84.
- Weber, Max. *The Protestant Ethic and the Spirit of Capitalism*. New York: Scribner, 1958.
- Winthrop, John. "A Modell of Christian Charity." In vol. 1 of *The Puritans*, edited by Perry Miller and Thomas H. Johnson, 195–99. New York: Harper Torchbooks, 1963.