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Gearing Up for the Next Industrial Revolution: 3D Printing, Home-Based Factories, and Modes of Social Control

Elizabeth J. Kennedy

Assoc. Prof. of Law & Social Responsibility, Loyola University Maryland

Andrea Giampetro-Meyer

Prof. & Chair of the Law & Social Responsibility Dept., Loyola University Maryland

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Gearing Up for the Next Industrial Revolution: 3D Printing, Home-Based Factories, and Modes of Social Control

Elizabeth J. Kennedy and Andrea Giampetro-Meyer***

While former industrial factories are being converted into modern living spaces in cities across the country, residential homes are being converted into modern factories thanks to advances in three-dimensional (“3D”) printing technology, an emerging “Maker Movement,” and the rise of online marketplaces like Etsy. Despite growing environmental, child-labor, and safety concerns, these “home-based factories” are largely unregulated. In the absence of traditional workplace protections, how can we gear up for the “next industrial revolution” while guarding against the sweatshop conditions of the last? How can we harness the Maker Movement’s commitment to do-it-yourself democracy in order to combat abuses by potential “corporate makers”? This Article analyzes the effectiveness of individual and collective “modes of social control” (e.g., law, ethical precepts, self-regulation, affinity groups, vigilant and effective media, and direct action) in creating and sustaining just workplaces in an age of 3D printing and home-based factories.

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* Associate Professor of Law & Social Responsibility, Loyola University Maryland.

** Professor and Chair of the Law & Social Responsibility Department, Loyola University Maryland.

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INTRODUCTION

The “Maker Movement”¹ promises to re-make America² and change the world.³ The billion-dollar movement⁴ is composed of “makers”:

1. See generally CHRIS ANDERSON, MAKERS: THE NEW INDUSTRIAL REVOLUTION (2012) (describing how today’s technology has liberated inventors from dependence on big manufacturers; communities of makers who share ideas, improve performance, and find efficiencies, together make something worth having).

2. Symposium, *Can The Maker Movement Re-Make America?*, TECHONOMY (Sept. 17, 2013), <http://teconomy.com/conf/13Detroit/the-new-teconomy/can-the-maker-movement-re-make-america/>; see Adrienne Jane Burke, *How the Maker Movement Is Reinventing Retail*, TECHONOMY (Sept. 19, 2013, 9:51 AM), <http://teconomy.com/2013/09/how-the-maker-movement-is-reinventing-retail/> (highlighting the success of two companies: Etsy and Shapeways); *Maker Movement*, P2P FOUND., http://p2pfoundation.net/Maker_Movement (last modified Oct. 1, 2014, 9:25 AM) (indicating that “maker companies are thriving”). But see Evgeny Morozov, *Making It: Pick Up a Spot Welder and Join the Revolution*, NEW YORKER, Jan. 13, 2014, at 69 (critiquing the maker movement); Tim Laseter & Jeremy Hutchison-Krupat, *A Skeptic’s Guide to 3D Printing*, STRATEGY+BUS., Winter 2013, at 20, 25, available at <http://www.strategy-business.com/article/00219?pg=all> (pointing out that “3D printing isn’t poised to take the place of factory production anytime soon” and that 3D printing will not change “the fundamental structure of global manufacturing” any time soon). Finally, for additional analysis suggesting that 3D printing has created hype, see Charles W. Finocchiaro, Note, *Personal Factory or Catalyst for Piracy? The Hype, Hysteria, and Hard Realities of Consumer 3D Printing*, 31 CARDOZO ARTS & ENT. L.J. 473, 476 (“3-D printing is far less likely to threaten intellectual property rights than peer-to-peer networks and file sharing services in the foreseeable future.”). To understand the unique language of the Maker Movement, see *The Language of the Maker Movement: 38 Terms for Teachers*, TE@CHTHOUGHT (Jan. 15, 2014), <http://www.teachthought.com/technology/language-of-the-maker-movement-38-terms-for-teachers/> (giving such examples as “Hack” means: “To strategically probe, analyze, break, or hi-jack; a revision of existing software or hardware to make it perform in a way other than it was designed”; “Make” means: “To move from design to product; to build, craft, conjure, code, or otherwise manifest”; or “Makerspace” means: “A garage space, classroom corner, work bench, design lab, or other area where the actual physical construction of designs occur”).

3. Gary Shapiro, *3D Printers Will Soon Change the World, if it’s Not Strangled in a Lawyered Up World*, FORBES (Jan. 17, 2014, 8:00 AM), <http://www.forbes.com/sites/realspin/2014/01/17/3d-printers-will-soon-change-the-world-if-its-not-strangled-in-a-lawyered-up-world>. But see J. F. Brandon, *3D Printing, China and Jobs – It’s Not What it Seems*, SOLIDSMACK (Jan. 23, 2013), <http://www.solidsmack.com/3d-cad-technology/3d-printing-china-and-jobs/> (pointing out that 3D printing is still very labor intensive).

4. Martha Stewart, *Meet USA’s New Entrepreneurs*, USA TODAY, Oct. 15, 2013, at B5 (“Makers pump some \$29 billion into the economy each year.”); Michael V. Copeland, *DIY*

artists, designers, and inventors⁵ who employ powerful, personal technology⁶ like three-dimensional (“3D”) printers, which spray extremely hot plastic on to a platform, layer upon layer, until a 3D object emerges.⁷ Under the banner of “do it yourself” (“DIY”),⁸ makers use 3D printers to create a wide range of products, from crafts, jewelry, and toys, to aerospace components, prosthetic devices, human body parts, and even housing.⁹ 3D-printing technology makes it possible to

Market Slows Dramatically as 3-D Printing Hits Its Industrial Stride, WIRED (May 24, 2013, 9:30 AM), <http://www.wired.com/2013/05/3d-printing-hits-its-industrial-stride-while-the-diy-market-slows-dramatically/> (“[T]he overall market for 3-D printing products and services hit \$2.2 billion in 2012, a compounded annual growth rate of almost 29 percent compared to the \$1.7 billion the industry recorded in 2011.”).

5. Martha Stewart, *supra* note 4, at B5 (suggesting that fifty-seven percent of the American population aged eighteen and older—approximately 135 million people—are makers). And for the eighteen-and-under crowd, Google and *Make: Magazine* hold Annual Maker Camps, with over 1 million children participating in the six-week online camp that “teaches teens to build, hack, and explore.” Josh Constine, *Google and Make Magazine Beat the Classroom with Virtual Science Camp for Teens*, TECHCRUNCH (July 8, 2013), <http://techcrunch.com/2013/07/08/google-maker-camp>.

6. See Tim Bjarin, *Why the Maker Movement is Important to America’s Future*, TIME (May 20, 2014), <http://time.com/104210/maker-faire-maker-movement/> (using Adweek’s definition of the Maker Movement). Additional technologies include robotics, artificial intelligence (“AI”), 3D printing, and nanotechnology. Joseph Flaherty, *MakerBot + Pinterest = Craft Juggernaut*, WIRED (April 18, 2012, 8:00 PM), <http://www.wired.com/2012/04/makerbot-pinterest-craft-juggernaut/> (“MakerBot sold approximately 7,500 machines since 2009, generating an estimated \$10 million to \$15 million in revenue.”); Vivek Wadhwa, *The End of Chinese Manufacturing and Rebirth of U.S. Industry*, FORBES (July 23, 2013, 9:30 AM), <http://www.forbes.com/sites/singularity/2012/07/23/the-end-of-chinese-manufacturing-and-rebirth-of-u-s-industry/> [hereinafter *Rebirth of U.S. Industry*]. In addition to 3D printers, other forms of technology supporting the Maker Movement include “laser cutters, easy-to-use design software, and desktop machine tools.” Fact Sheet, White House, Office of the Press Secretary, President Obama to Host First-Ever White House Maker Faire (June 18, 2014), *available at* <http://www.whitehouse.gov/the-press-office/2014/06/18/fact-sheet-president-obama-host-first-ever-white-house-maker-faire>.

7. William Marshall, *Can US Hold Its Lead on 3D Printing?*, PROGRESSIVE POL’Y INST. (Aug. 23, 2013), <http://www.progressivepolicy.org/2013/08/can-us-hold-its-lead-on-3d-printing/>. This is similar to inkjet printers, only inkjet printers apply just one layer while 3D printers apply layer upon layer. “3D printing – known in the trade as additive manufacturing – fuses successive layers of material, most commonly plastic, into what are now fairly crude, three-dimension objects.” *Id.*

8. See generally *DIY CITIZENSHIP: CRITICAL MAKING AND SOCIAL MEDIA* (Matt Ratto & Megan Boler eds., 2014) (compiling DIY- and technology-related articles).

9. *Rebirth of U.S. Industry*, *supra* note 6. In addition, makers have produced guns, fabric, and sex toys with 3D printers. For articles exploring guns, see, e.g., Julian J. Johnson, *Print, Lock, and Load: 3-D Printers, Creation of Guns, and the Potential Threat to Fourth Amendment Rights*, 2013 U. ILL. J.L. TECH. & POL’Y 337 (2013) (arguing in favor of a regulatory approach to the threat of guns created by 3D printers and criminalizing the individuals and companies that manufacture or possess 3D-printed guns); Jean-Yves Meyer, *The Basin of the Danaides: How 3-D Printing Will Push the Limits of International Gun Control and Digital Freedom of Speech in the Twenty-first Century*, 41 DENV. J. INT’L L & POL’Y 555, 555 (2012–2013) (“3-D printing will

manufacture products inside a private home or apartment, and then sell those products through online marketplaces like Etsy and Ebay, turning homes into home-based factories. Futurists predict that by the end of this decade, “we will see 3D printers doing the small-scale production of previously labor-intensive crafts and goods,”¹⁰ jumpstarting local industry and “bring[ing] manufacturing back home.”¹¹

Armed with this technology, makers see themselves as crafters with global connectivity.¹² The Maker Movement views itself “at the intersection of a series of tensions: between consumers and citizens, between experts and novices, between individuals and communities, and between politics as performed by governments and politics and DIY grassroots democracy.”¹³ Nowhere is this better illustrated than in the concept of the home-based factory. Despite growing concerns about environmental and health hazards, child labor, and minimum-wage

revolutionize the current balance of regulation involved with international arms trafficking and digital freedom of speech by greatly democratizing and decentralizing the manufacturing of arms worldwide.”). For an article about 3D printing and fabric, see Charlie Stross, *The Revolution Will not be Hand-Stitched*, CHARLIE’S DIARY (Nov. 15, 2013, 11:50 AM), <http://www.antipope.org/charlie/blog-static/2013/11/the-next-revolution-will-not-b.html> (discussing Fabrican, a fabric in a spray can, and noting that technology is only five to twenty years from 3D printing woven fabric). One commentator noted that in 2013, “the Munich-based 3M futureLAB . . . a group that included UCLA architecture students produced what they billed as the world’s first apartment using only 3-D technology—fully furnished and complete with bedroom, bathroom, kitchen and living space, if a bit cramped at about 37 square feet.” Dan Gordon, *The Revolution will be Printed in 3-D*, UCLA MAG., Apr. 1, 2014, available at <http://magazine.ucla.edu/features/the-revolution-will-be-printed-in-3-d/>. Peter Ebner, who was in charge of the project, “predict[ed] that over the next two decades, 3-D printing will overtake construction in architecture as part of ‘the next industrial revolution.’” *Id.*

10. *Rebirth of U.S. Industry*, *supra* note 6; see Jeremiah Owyang, *Maker Movement and 3D Printing: Industry Stats*, WEB STRATEGIST (Feb. 13, 2014), <http://www.web-strategist.com/blog/2014/02/13/maker-movement-and-3d-printing-industry-stats/> (“[The] 3D printing market is expected to grow at a CAGR of 23% from 2013 to 2020 and reach \$8.41B in 2020.” (quoting MARKETSANDMARKETS, 3D PRINTING MARKET TECHNOLOGY, MATERIALS, APPLICATION & GEOGRAPHY (2013))).

11. Matt King, *On Labour, Unions and 3D Printing*, ARBITRAGE MAG., May 2013, at 35, available at <http://www.arbitragemagazine.com/technology-2/on-labour-unions-and-3d-printing/> (“The global recession . . . has inspired a political pressure on companies to create jobs locally.”). As President Obama remarked, “[t]oday’s D.I.Y. is tomorrow’s ‘Made in America.’ [Maker-built 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.” President Barack Obama, Remarks at the White House Maker Faire (June 18 2014), available at <http://www.whitehouse.gov/the-press-office/2014/06/18/remarks-president-white-house-maker-faire>.

12. David Rejeski, *The Next Industrial Revolution: How We Will Make Things in the 21st Century and Why it Matters*, 43 ENVTL. L. REP. NEWS & ANALYSIS 10232, 10232 (2013).

13. DIY CITIZENSHIP, *supra* note 8, at 5.

violations, such “makerspaces”¹⁴ are largely unregulated.¹⁵ In the absence of traditional workplace safety nets and legal protections (a common feature of the “sharing” and “disruptive” economies in which the Maker Movement is situated),¹⁶ workplace abuses in the “next industrial revolution” may mirror the abuses that characterized the last.¹⁷

How, then, can we ensure that 3D printers do not facilitate a new generation of home-based sweatshops? How can we harness the Maker Movement’s commitment to DIY grassroots democracy in order to guard against abuses by “corporate makers” and protect marginalized workers? Both individualistic and collectivist approaches can help the Maker Movement establish and enforce fair workplace standards within home-based factories. Yet, to date, the emphasis on regulating or restricting the use of 3D-printing technology has focused almost exclusively on intellectual property and gun control concerns. As we gear up for the next industrial revolution, we must also anticipate the promise and potential dangers of the Maker Movement in the context of the home-based workplace.¹⁸

14. For a definition of “makerspaces,” see *The Language of the Maker Movement: 38 Terms for Teachers*, *supra* note 2.

15. Wendy Cunningham & Carlos Ramos Gomez, *The Home as Factory Floor: Employment and Remuneration of Home-based Workers* 3 (World Bank, WPS 3295, 2004), available at <http://siteresources.worldbank.org/INTMNAREGTOPGENDER/Resources/HomeFactoryFloor-ENG.pdf> (“[H]ome-based work is primarily undertaken by women and their children who perform simple, repetitive, labor-intensive tasks for long hours and low wages. Since the work is performed in the privacy of one’s home, the workers are subject to poor work conditions, few legal protections, and isolation.” (citations omitted)).

16. Veronica Bayetti Flores, *The Sharing Economy, Gender, and Why Individualistic Solutions Won’t Disrupt Neoliberalism*, FEMINISTING, <http://feministing.com/2014/05/28/gender-the-sharing-economy-and-why-individualistic-solutions-wont-disrupt-neoliberalism/> (last visited Apr. 26, 2015).

17. Susie Cagle, *The Case Against Sharing*, THE NIB (May 27, 2014), <https://medium.com/the-nib/9ea5ba3d216d>; see Michelle Chen, *Wage Theft, Dangerous Conditions and Discrimination: Inside New York’s Food Industry*, THE NATION (July 1, 2014, 11:00 AM), <http://www.thenation.com/blog/180470/wage-theft-dangerous-conditions-and-discrimination-inside-new-yorks-food-industry> (contrasting the poor working conditions for laborers in the artisanal and craft food industries—arguably a “foodie revolution”—in New York City).

18. Another important area is intellectual property. For articles that explore intellectual property law issues, see, e.g., Joseph C. Storch, *3-D Printing Your Way Down the Garden Path: 3-D Printers, the Copyrightization of Patents, and a Method for Manufacturers to Avoid the Entertainment Industry’s Fate*, 3 N.Y.U. J. INTELL. PROP. & ENT. L. 249 (2014) (arguing in favor of moral persuasion and market model pricing to protect tangible goods manufacturers as 3D printing presents a threat to their intellectual property rights); Kyle Dolinsky, Note, *CAD’s Cradle: Untangling Copyrightability, Derivative Works, and Fair Use in 3D Printing*, 71 WASH. & LEE L. REV. 591 (2014) (posing a new test that considers a CAD file’s drawing and code components separately); Skyler R. Peacock, Note, *Why Manufacturing Matters: 3D Printing*,

This Article explores how individual and collective “modes of social control” (e.g., law, ethics, self-regulation, affinity groups, the media, and citizen activism) can incentivize corporations¹⁹ and organizations²⁰ to create and sustain fair workplaces in an age of 3D printing and home-based factories. Part I imagines home-based factories and the processes of additive manufacturing as they are likely to emerge, and presents a factory typology based on scale, product, and production methods. Part II introduces, applies, and analyzes six “modes of social control” with the potential to establish and sustain just workplace standards in the context of home-based factories. The modes are organized into two sets. The first set highlights individualistic approaches to control—ethical precepts, self-regulation, and affinity group standards. Ethical principles serve as the anchor for this set, as one particular approach to ethics²¹ holds great promise for inspiring good maker-inspired companies. The second set highlights collectivist approaches to control—law, a vigilant and responsible media, and direct citizens’ action. Law serves as the anchor for this set, as rules, collectively determined and obeyed by all,²² hold great promise for inspiring good maker-inspired companies. This Article contributes new ways of thinking about 3D printing and home-based factories by considering ways technology might shape the home-based workplace in this new industrial revolution.

Computer-Aided Designs, and the Rise of End-User Patent Infringement, 55 WM. & MARY L. REV. 1933 (2014) (arguing for market-based responses to 3D printing issues, rather than legislative action). For an article exploring 3D printing and product liability, see Nora Freeman Engstrom, *3-D Printing and Product Liability: Identifying the Obstacles*, 162 U. PA. L. REV. ONLINE 35 (2013) (suggesting that, if home 3D printing takes off, product-liability law will change drastically, as the new technology “threatens to unsettle the theoretical justification for product liability law’s development”).

19. E.g., Edward M. Epstein, *The Good Company: Rhetoric or Reality? Corporate Social Responsibility and Business Ethics Redux*, 44 AM. BUS. L.J. 207, 210–12 (2007) (focusing on transnational corporations (“TNCs”)).

20. We are extending this framework to other organizational forms, including proprietorships and partnerships.

21. See Robert G. Kennedy, *Virtue and Corporate Culture: The Ethical Formation of Baby Wolverines*, 17 REV. BUS. 10, 12–14 (1995) (explaining the virtue theory, which is one particular approach that is especially relevant); see also TERRY HALBERT & ELAINE INGULLI, *LAW & ETHICS IN THE BUSINESS ENVIRONMENT* 14–20 (7th ed. 2012) (explaining that additional ethics theories include utilitarianism, which assesses consequences, and deontology, which emphasizes rights and duties).

22. See generally John Miller, *Why Economists Are Wrong About Sweatshops and the Antisweatshop Movement*, 46 CHALLENGE 93, 96–98 (2003).

I. IMAGINING HOME-BASED FACTORIES

A. Additive Manufacturing

As we think about how to promote just working conditions within home-based factories, it is important to understand the various types of manufacturing that might take place inside. Two traditional manufacturing methods that are finding new application in the era of 3D printing are injection molding²³ and machining.²⁴ Injection molding produces parts by injecting a range of materials, from glass to thermoplastic polymers, into a mold, where the materials cool and harden into the part. Today, some kinds of molds can be created using 3D-printing technology.²⁵ Injection molding is the most common method for manufacturing parts, and it is ideal for producing high volumes of the same object.²⁶ Machining, by contrast, is used to describe a variety of processes in which a piece of raw material (e.g., aluminum or steel) is cut into a desired final shape and size by a process that removes the material, and is also known as “subtractive manufacturing.”²⁷

The Maker Movement utilizes *nontraditional* forms of manufacturing because, at its core, it centers on “craft.” While injection molding and machining are used to mass-produce objects, craft is concerned with “producing things in small batches for niche markets.”²⁸ 3D printing allows crafters to customize each product, because they typically use the technology to make only one item at a time, due in part to the size limitations created in 3D printing, and in part because the products created by crafters are usually in response to individual customer demand. By using this form of additive manufacturing,²⁹ crafters are considered a new class of manufacturers. In addition to creatively adapting technology to the particular needs of their craft construction,

23. *When to Use 3D Printing vs. Traditional Manufacturing for Production*, SOLID CONCEPTS <http://www.solidconcepts.com/resources/white-papers/use-3d-printing-vs-traditional-manufacturing-production/> (last visited Apr. 26, 2015).

24. *Id.*

25. *Id.*

26. Chen, *supra* note 17.

27. For a discussion of subtractive 3D printing, see Mark Albert, *Subtractive Plus Additive Equals More Than (- + + = >)*, MODERN MACHINE SHOP (Jan. 17, 2011), <http://www.mmsonline.com/columns/subtractive-plus-additive-equals-more-than>.

28. Erick Schonfeld, *Turning Makers Into Middle Class Manufacturers*, TECHONOMY (Oct. 4, 2014, 9:29 AM), <http://techonomy.com/2012/10/makers-middle-class-manufacturers/?section=video>.

29. Marshall, *supra* note 7.

makers are especially good at creating emotional connections with customers.³⁰ Internet platforms, like Etsy,³¹ provide an opportunity for customers to find products that “start conversations, make them feel special and unique, and connect on a personal, human level” with the people that make those products.³² Despite trading on an aesthetic that celebrates crocheted iPhone cozies and Mason jar lanterns, Etsy is a multi-national business valued at over \$600 million.³³ While the technology may be non-traditional, and the items for sale appear non-corporate, it would be reckless to disregard the powerful economic forces undergirding the Maker Movement.

B. Environmental Health Hazards

Researchers are beginning to take note of the dangers that new technology and makerspaces may pose to crafters and consumers.³⁴ For example, with regard to 3D printing, preliminary studies raise questions about user safety.³⁵ The most significant risk is that “some of these

30. Schonfeld, *supra* note 28.

31. See *About Etsy*, ETSY, <https://www.etsy.com/about> (last visited Apr. 26, 2015) (“Etsy is a marketplace where people around the world connect, both online and offline, to make, sell and buy unique goods.”); *Mission & Values*, ETSY, <https://www.etsy.com/mission> (last visited Apr. 26, 2015), (“Our mission is to re-imagine commerce in ways that build a more fulfilling and lasting world.”).

32. Alexandria Ferguson, *Celebrating Small: 3 Small Ways to Hone Your Competitive Edge*, ETSY (Mar. 18, 2014), <https://blog.etsy.com/en/2014/celebrating-small-3-ways-to-hone-your-competitive-edge-3/>.

33. See Diana Adams, *Etsy’s Growth May Surprise You: The Facts & Stats*, BIT REBELS, <http://www.bitrebels.com/social/etsys-growth-may-surprise-you-the-facts-stats-infographic/> (last visited Apr. 26, 2015) (detailing further that Etsy has 875,000 shops, 13,000,000 items, 2,900,000 items sold per month and 15,000,000 Etsy DIYers in over 150 countries, with 690,000 new members joining every month); see also ETSY, REDEFINING ENTREPRENEURSHIP: ETSY SELLERS’ ECONOMIC IMPACT 4 (2013) [hereinafter ETSY, REDEFINING ENTREPRENEURSHIP], available at https://blog.etsy.com/news/files/2013/11/Etsy_Redefining-Entrepreneurship_November-2013.pdf (explaining that Etsy provides a reasonable salary and allows individuals to work from the home).

34. See, e.g., Somini Sengupta, *Silicon Valley Techies Fight to Save a Popular but Illegal Haven*, N.Y. TIMES, Jul. 22, 2012, at B7 (explaining that additional safety concerns focus on whether maker/hacker spaces “have enough fire exits, sprinklers or wheelchair-accessible bathrooms . . .”).

35. E.g., *3D Printers May Pose Indoor Air Pollution Risk*, GALLONDAILY (July 29, 2014), <http://gallondaily.com/2013/07/29/3d-printers-may-pose-indoor-air-pollution-risk/> (discussing a study on 3D printers’ air emissions performed by Dr. Brent Stephens’) [hereinafter *Indoor Air Pollution Risk*]; see Thomas Burke, *3D Printing is the Future, But Safety Comes First*, INFORMATIONWEEK (Jan. 16, 2014, 9:06 AM), <http://www.networkcomputing.com/applications/3d-printing-is-the-future-but-safety-comes-frist/a/d-id/1113457> (stating that “history has proven time and again, from medical devices to cleaning products, that the growth associated with a new technology (or application of it) must be safe and sustainable to succeed,” and noting that safety risks include high-voltage and hot equipment and airborne emissions); Tyler Falk, *3D Printers*

[3D] printers emit ultrafine particles (UFPs) at concentrations that may be hazardous in confined spaces.”³⁶ Right now, 3D printers use heated plastic resins that the printer sprays from “very fine nozzles.”³⁷ The process of heating and spraying the plastic—which causes it to decompose slightly—creates a form of indoor air pollution.³⁸

UFPs are known to deposit in lungs and can lead to stroke, asthma, and death.³⁹ A group of scientists from the Illinois Institute of Technology led by Dr. Brent Stephens, found that the levels of UFPs emitted from 3D printers is “significant.”⁴⁰ In discussing the study, one commentator noted that “care should be taken when using 3D printers in indoor environments without adequate particle filtration and ventilation.”⁴¹ The safety risks posed by 3D printing raise concerns about the health of future countertop creators (and their families), when makers transform their own homes into factories.⁴²

One would not expect that those with progressive politics who are part of the Maker Movement would engage in unjust labor practices.⁴³ But as this Movement grows, individual makers may morph into (or contract with) corporate-sized manufacturers, and, in the process, retreat

Have a Dirty Secret, SMARTPLANET (July 25, 2013, 1:07 AM), <http://www.smartplanet.com/blog/bulletin/3d-printers-have-a-dirty-secret/> (“Before you buy an amazing desktop 3D printer, know this: that mini-factory-in-a-box could be harmful to your health.”); Lyndsey Gilpin, *The Dark Side of 3D Printing: 10 Things to Watch*, TECH REPUBLIC (March 5, 2014, 4:51 AM), <http://www.techrepublic.com/article/the-dark-side-of-3d-printing-10-things-to-watch/> (“3D printers are still potentially hazardous, wasteful machines, and their societal, political, economic, and environmental impacts have not yet been studied extensively.”); Dominique Mosbergen, *3D Printers May Be As Hazardous To Your Health As Cigarettes, According to New Study*, HUFF. POST (July 24, 2013, 6:48 PM), http://www.huffingtonpost.com/2013/07/24/3d-printers-health_n_3646133.html (“[I]n a factory, an operator might be required to wear protective gear and there might be better ventilation [than in a home]. Previous research has suggested that high concentrations of UFPs in the body can cause asthma symptoms, stroke, cardiac arrest and even death.” (citations omitted)).

36. *Indoor Air Pollution Risk*, *supra* note 35.

37. *Id.*

38. *Id.*

39. *Id.*

40. Brent Stephens et al., *Ultrafine Particle Emissions from Desktop 3d Printers*, ATMOSPHERIC ENV'T, Nov. 2013, at 334, available at <http://www.sciencedirect.com/science/article/pii/S1352231013005086>

41. *Indoor Air Pollution Risk*, *supra* note 35.

42. See generally Sengupta, *supra* note 34 (detailing how nontraditional startups and new makerspaces struggle to handle the cost of compliance with local and state workplace safety regulations).

43. Mirit Eyal-Cohen, *Why is Small Business the Chief Business of Congress?*, 43 RUTGERS L.J. 1, 24–28 (2011) (describing the small-business form as one that promotes social justice); see King, *supra* note 11 (explaining how 3D printing can counter-balance the globalizing effects of outsourcing manufacturing by instead localizing manufacturing and can also create new jobs).

from the progressive politics that originally inspired their formation.⁴⁴ Moreover, makers are not a monolithic group with a uniform set of shared values. We must, therefore, consider the possibility that some makers who create home-based factories will disregard rules that prohibit child labor, protect workers' health and safety, and ensure fair wages and hours. It would be instructive for makers to review the historical record regarding "homework,"⁴⁵ especially the child labor that produced artificial flowers, garment finishing, and cigars in urban tenements during the early- to mid-1900s.⁴⁶ Although historical abuses involving child labor inspired protective legislation, Congress has weakened these protections in recent years, arguing in favor of freedom and against the concept of regulating work within individual homes.⁴⁷

44. ETSY, REDEFINING ENTREPRENEURSHIP, *supra* note 33, at 3. Etsy sellers do not identify as hobbyists. According to an Etsy survey of 5500 Etsy sellers, they are "independent, self-sufficient and want to stay that way." *Id.* at 2. Seventy-four percent consider their Etsy shops as businesses and ninety-one percent aspire to grow their sales in the future. *Id.* Eighty-eight percent are women, ninety-seven percent run their businesses from home, and they are geographically dispersed around the United States. *Id.* Income earned on Etsy is used for household expenses, discretionary spending, savings and investment. *Id.*

45. The Progressive reformers of the early twentieth century documented the widespread, persistent, and vexing problem of child labor in cramped and crowded urban tenements. *See, e.g.*, Mary Van Kleeck, *Child Labor in New York City Tenements*, reprinted in SELECTED ARTICLES ON CHILD LABOR 123, 124 (H.W. Wilson Co. 1911), (illustrating the working conditions of children in tenement houses in New York City during 1906 and 1907); JACOB RIIS, HOW THE OTHER HALF LIVES: STUDIES AMONG THE TENEMENTS OF NEW YORK 139-41 (1890) (discussing how entire families worked together to roll and package cigars). Although New York prohibited children under fourteen from working in factories or stores, the ban did not extend to the apartments and tenements south of Fourteenth Street, which operated as in-home manufacturing plants. Some reformers speculated that it was the ban on child labor in the factory that pushed the work back onto children in unregulated homes. *See* Van Kleeck, *supra*, at 123-24.

46. Most protective workplace legislation was born in response to the abuses and tragedies resulting from the unregulated excesses of industrial capitalism. *See, e.g.*, DAVID VON DREHLE, TRIANGLE: THE FIRE THAT CHANGED AMERICA 215 (Atlantic Monthly Press 2003).

47. Today, homeworkers are defined as employees who perform their work at home but are not self-employed. Katherine V. W. Stone, *Legal Protections for Atypical Employees: Employment Law for Workers Without Workplaces and Employees Without Employers*, 27 BERKELEY J. EMP. & LAB. L. 251, 270 (2006). Most are "telecommuters," whose ability to work from home derives from advances in electronic communication. *Id.* While such employees would not likely identify with the label of "industrial homeworker," for most purposes they are treated as such under each of the individual legal protections discussed below. According to the U.S. Census Bureau, 390,000 people worked in manufacturing at home in 2010. PETER J. MATEYKA, MELANIE A. RAPINO & LIANA CHRISTIN LANDIVAR, HOME-BASED WORKERS IN THE UNITED STATES: 2010, at 9 (2012), available at <http://www.census.gov/prod/2012pubs/p70-132.pdf>. While the number of workers in the manufacturing industry declined significantly between 2000 and 2010 (from 17,932,000 to 14,187,000), the number of manufacturing employees working from home increased as both a raw number and percentage of the industry (from 279,000 to 390,000). *See id.* at 11 tbl.7 (showing the percentage of workers who work

Violations of labor laws persist. For instance, in 1995, police in El Monte, California found and raided a concealed garment sweatshop, operating out of a suburban home, where seventy-two Thai immigrants were held in captivity as they sewed clothes for brand-name labels.⁴⁸ The Maker Movement and its various stakeholders (consumers, workers, regulators, and activists) must be proactive in guarding against such labor-law violations as home-based factories take shape.

C. Maker Movement Foundations

Actors from both the political right and the political left have embraced the Maker Movement.⁴⁹ For right-leaning actors, the Maker Movement's foundation is individualism: "each individual is the controlling factor in shaping personal destiny."⁵⁰ For individualists, the ethical norms of freedom,⁵¹ prosperity,⁵² and self-fulfillment⁵³ are paramount. The individualist is likely to highlight personal empowerment,⁵⁴ make statements about "man taking over the machines,"⁵⁵ and be wary of regulation.⁵⁶

Conversely, for left-leaning actors, the Maker Movement's foundation is collectivism: makers are interconnected with other makers

from home by class of worker).

48. Miller, *supra* note 22, at 99–100.

49. Jathan Sadowski & Paul Manson, *3-D Print Your Way to Freedom and Prosperity: The Hidden Politics of the 'Maker' Movement*, AL JAZEERA (May 17, 2014, 12:00 AM), <http://america.aljazeera.com/opinions/2014/5/3d-printing-politics.html>.

50. Nancy Kubasek, M. Neil Browne & Michael D. Meuti, *It Takes an Entire Village to Protect an Endangered Species: Individualism, Overlapping Spheres, and the Endangered Species Act*, 10 FORDHAM ENVTL. L. REV. 155, 158 (1999) (quoting Andrea Giampetro-Meyer et al., *Advancing the Rights of Poor and Working-Class Women in an Individualistic Culture*, 2 LOY. POVERTY L.J. 41, 42 n.3 (1996)).

51. Sadowski & Manson, *supra* note 49.

52. *Id.*

53. See Justin Reich, *The Lure of the Technological Sublime: Morozov and the Makers*, EDUC. WEEK (Jan. 12, 2014, 3:39 PM), http://blogs.edweek.org/edweek/edtechresearcher/2014/01/the_lure_of_the_technological_sublime_morozov_and_the_makers.html (discussing how Steve Jobs saw hacking and personal computing as a means to self-fulfillment, rather than political activism).

54. *But see infra* text accompanying note 69 (discussing how companies like Etsy can negatively impact one's empowerment).

55. See Burke, *supra* note 2 (explaining how the Maker Movement will cause man to take over machines once again and start a "new American industrial revolution").

56. See M. Neil Browne & Michael D. Meuti, *Individualism and the Market Determination of Women's Wages in the United States, Canada, and Hong Kong*, 21 LOY. L.A. INT'L & COMP. L.J. 355, 357 (1999) (discussing the link between the concept of individualism and denouncing regulation of the marketplace).

and segments of society.⁵⁷ These actors believe that decisions about the nature of work should reflect political voice and community consensus.⁵⁸ The collectivist is likely to highlight group well-being,⁵⁹ progressive social change,⁶⁰ and the importance of democracy⁶¹ to constructing rules and actions that protect workers and the larger society. The collectivist is wary of pure market decision making, as market decision making often ignores externalities,⁶² such as pollution and health problems that might arise from new methods of production.

D. Factory Typology

As 3D printing evolves, home-based factories are likely to fall into three categories. The first two highlight the what and how of making, while the third highlights the who and how of making.⁶³ The first type of home-based factory, which we call a Type I factory, is established when an artisan uses a 3D printer to make handicrafts. One example is Han-Yin Hsu, a jewelry designer who sends her pendant designs to a company, Shapeways,⁶⁴ which prints and ships them back to Hsu.⁶⁵ Hsu, working from home, attaches the pendants to chains, and ships the finished products to her Etsy customers.⁶⁶ Hsu looks forward to owning her own 3D printer, which will enable her to handle every step in the production process within her own home.⁶⁷ It is important to note that most crafters who fall into Type I are women seeking “top-up”

57. Kate Milberry, *(Re)making the Internet: Free Software and the Social Factory Hack*, in *DIY CITIZENSHIP*, *supra* note 8, at 53–54; Alison Powell, *Cultures of the “Maker” Movement*, ALISON POWELL (Dec. 19, 2012), <http://www.alisonpowell.ca/?p=522>.

58. Sadowski & Manson, *supra* note 49; *see* Browne & Meuti, *supra* note 56, at 360 (“[Collectivists] are more likely to implement economic policies that rely on political voice, rather the supply and demand readings that drive the market.”).

59. Powell, *supra* note 57.

60. *Id.*

61. Sadowski & Manson, *supra* note 49.

62. Externalities arise when firms create social costs that they do not have to bear, such as pollution. Thus, society must impose regulations and penalties so that firms “‘internalize’ these externalities.” Michael E. Porter & Mark R. Kramer, *Creating Shared Value*, HARV. BUS. REV., Jan.–Feb. 2011, at 65.

63. The authors have created these types themselves, the boundaries of which can blur, e.g., when an Etsy seller places products in larger retailers like Nordstrom.

64. Crafters can also access “‘printing’ at modern-day Kinko’s: shared public manufacturing facilities such as TechShop.” *See Rebirth of U.S. Industry*, *supra* note 6 (explaining how an individual can transform its design into a product).

65. Elizabeth Palermo, *How 3D Printing is Changing Etsy*, TOM’S GUIDE (Aug. 7, 2013, 5:14 PM), <http://www.tomsguide.com/us/3d-printing-changing-etsy,review-1834.html>.

66. *Id.*

67. *Id.*

income,⁶⁸ or income to supplement the wages provided by a primary breadwinner.⁶⁹ Currently, very few support themselves and their families through crafting, a situation that is for some voluntary and for others the bitter reality that Etsy is not a universal path to economic self-sufficiency.⁷⁰

We can imagine how a Type I factory might unintentionally foster substandard working conditions. Suppose that a woman starts a home-based factory, Surina Shoes, to manufacture 3D-printed footwear.⁷¹ As her business grows, and with mixed feelings, she utilizes her eleven-year-old daughter in order to meet the increased demand. On one hand, she believes that by printing shoes after school and on the weekends,

68. According to Etsy, its sellers are characteristic of a larger shift to flexible work. Only eighteen percent sell goods full-time, and twenty-six percent have other full-time traditional jobs. ETSY, REDEFINING ENTREPRENEURSHIP, *supra* note 33, at 3. Etsy touts women's "empowerment through a 'very-very small business' model," just as micro-enterprise and micro-finance is lauded as a platform for global micro-enterprise and women's development. EMILY MATCHAR, HOMEWARD BOUND: WHY WOMEN ARE EMBRACING THE NEW DOMESTICITY 92–93 (2013). Such an enterprise model is even more attractive in a nation like the United States, where women overwhelmingly lack supports like paid maternity leave and affordable child care. *Id.* at 92.

69. See Susan Luckman, Gender, Craft and the Creative Economy: Home-based Cultural Work and the Etsy Mum (Hawke Research Inst.), *available at* <http://www.inter-disciplinary.net/critical-issues/wp-content/uploads/2013/07/luckmanvowpaper.pdf>. The Author discusses her own views on the new Etsy-influenced market:

I find myself torn by this post-Etsy cultural economy. One [sic] the one hand, working from home is an attractive option for women accustomed to paid work, but now also finding themselves with caring responsibilities within the household. As more women in the Global West graduate from higher education and/or have a career outside the home prior, or concurrently to having children, the networked home is becoming a normalised paid work location. This is no huge leap in many ways for women for while, as Sennett, quoting Adam Smith, has noted, the 'separation of home and labor is . . . the most important of all the modern divisions of labour', feminists have long challenged the invisibility of women's labour which precisely enables the construction of divisions such as this. Distribution and marketing sites such as Etsy can therefore slot easily into this environment, and via the handmade continue the long, but previously less visible, tradition of middle-class women using their creative skills to contribute from home to the family income. But on the other hand, I am interested in what 'choice' really means here. With childcare prohibitively expensive in the industrialised world, this 'choice' seems strongly correlated with women and young mothers. Why are not other women or more men making this 'choice[']? Is such 'choice' simply a 'making do', a trade-off or de Certeauian 'tactic' enacted in the face of the larger strategies of commerce and gender inequality?

Id. (footnotes omitted)

70. *Id.*; see ETSY BITCHES, <http://etsybitch.blogspot.com/> (last visited Apr. 26, 2015) (blogging about complaints against Etsy's management).

71. See, e.g., Shane Taylor, *3D Shoes: Excellent Design Meets 3D Printed Personalisation*, 3D PRINTING INDUS. (Oct. 14, 2014), <http://3dprintingindustry.com/2014/10/14/3d-shoes-design-3d-printed/> (discussing the kind of shoes 3D printers can produce and the benefits of personalizing the shoes to each customer).

her daughter will learn responsibility by supporting the family business. On the other hand, she wonders whether the 3D printer is too dangerous for a child to operate, especially at such high temperatures. This particular Type I factory may inadvertently violate multiple workplace laws and global labor standards.

The second type of home-based factory, a Type II factory, is similar to Type I, but scientist-artists—not crafters—use 3D printing to make electronics kits,⁷² rather than handicrafts. An example is Ayah Bdeir’s littleBits, which makes an open source library of electronic components that snap together with magnets.⁷³ Bdeir, an engineer and artist,⁷⁴ is a leader in the open-hardware movement, which sits at the nexus of craft and hacking.⁷⁵ Type II factory founders “push on the space between electronics, art, and craft creation.”⁷⁶ Two features of Type II factories are interesting. First, many entrepreneurs in this category are women, in contrast with the heavily male-dominated technology industry outside of which these home-based factories are likely to exist. Second, Type II makers appear to be more financially stable and independent.⁷⁷ Some makers have shifted careers, from highly lucrative positions in industry or finance, to entrepreneurial tracks.⁷⁸ Additionally, Type II factory founders are more likely than Type I artisans to attract the attention of venture capitalists.⁷⁹

72. Powell, *supra* note 57.

73. See, e.g., *Smart Home Kit*, LITTLEBITS ELECTRONICS, <http://littlebits.cc/?gclid=CJ2eXZjtsb8CFabm7AodgEIA1A> (last visited Apr. 26, 2015) (showing an example of the Smart Home Kit).

74. See *Bio*, LITTLEBITS ELECTRONICS, <http://littlebits.cc/bio> (last visited Apr. 26, 2015) (showing the biography of founder Ayah Bdeir); see also *Stem to Steam*, RISD, http://www.risd.edu/about/stem_to_steam/ (last visited Apr. 26, 2015) (describing the program STEM to STEAM, which has a mission to add art and design to science, technology, engineering, and math).

75. Powell, *supra* note 57. In the Maker Movement, hacking has the positive connotation of celebrating the work of makers who revise hardware to make it perform in a way other than as it was designed. See Luckman, *supra* note 69 (explaining the model in which people craft at home as a career).

76. Powell, *supra* note 57; see *STEM to STEAM*, STEM TO STEAM, <http://stemtosteam.org/> (last visited Apr. 26, 2015) (explaining the STEAM movement, which involves adding art and design to the sciences).

77. Claire Cain Miller, *For Women in Tech, Pay Gap is Unusually Small*, N.Y. TIMES, Apr. 24, 2014, at B3, http://www.nytimes.com/2014/04/25/upshot/flexibility-is-the-reason-for-a-small-er-pay-gap-in-tech-work.html?_r=0&abt=0002&abg=0.

78. See Anand Giridharadas, *The Kitchen-Table Industrialists*, N.Y. TIMES MAG., May 15, 2011, http://www.nytimes.com/2011/05/15/magazine/the-kitchen-table-industrialists.html?pagewanted=all&_r=0 (discussing how Ayah Bdeir went from working in a “plush” office in New York to starting her own business).

79. Andreessen Horowitz invested \$30 million in Shapeways, putting its confidence into the

As a consequence of their more sound financial foundation, Type II factories might evolve in separate loft spaces (rather than individual homes), and, at that point, company founders and employees would be more likely to enjoy livable compensation packages, including benefits.⁸⁰ However, it is easy to envision how such a company might still foster substandard home-based working conditions. Imagine a company, Zinda Watches, which operates out of a Brooklyn loft-space where it creates 3D-printed kits that allow customers to assemble watches.⁸¹ After Oprah picks a Zinda watch kit as one of her “favorite things” in 2015,⁸² demand for the kits skyrockets. To meet the increased demand, Zinda hires independent contractors. Although Zinda is unaware, these “dependent contractors,”⁸³ who only manufacture the Zinda kits, do so for what amounts to less than minimum wage.

The third type of home-based factory, a Type III factory, could make any kind of manufactured product. What distinguishes a Type III

3D-printing industry. Previously, Shapeways raised \$5 million to spin out of Philips. See Michael V. Copeland, *The \$30M Bet That Shapeways Becomes a Factory for Everyone*, WIRED (Apr. 23, 2013, 9:00 AM), <http://www.wired.com/2013/04/30-million-bet-that-shapeways-becomes-a-factory-for-everyone/> (discussing how Horowitz invested in Shapeways and 3D printing); Pete Weijmarshausen, *Shapeways Raises \$5M and Opens HQ in New York*, SHAPEWAYS BLOG (Sept. 23, 2010), <http://www.shapeways.com/blog/archives/595-shapeways-raises-5m-and-opens-hq-in-new-york.html> (explaining how Shapeways raised \$5 million to become an independent company).

80. Giridharadas, *supra* note 78. “The new personal factories may seem like crude toys for only the most die-hard D.I.Y.-ers. But in technology circles, they are talked about as a looming revolution that could change the way people work and create new opportunities for millions.” *Id.* Giridharadas also describes Adafruit Industries, which:

[S]ells do-it-yourself electronic kits, which they manufacture and ship so that you, in turn, can make your own crude iPod equivalent or bespoke baby monitor or D.I.Y. phone charger. They are regarded as trailblazers among their fellow makers, because they actually manufacture in Manhattan, and profitably In Adafruit’s spacious loft, seven full-time employees, Torrone and Fried, the engineer-founder who owns the company, labor away on the kits. The full-timers are paid more than \$50,000 a year and receive health benefits

Id. Giridharadas notes that “[i]t was surreal to do this assembly-line work in Lower Manhattan.” *Id.*

81. Adafruit Industries makes kits to create watches. See, e.g., *TIMESQUARE DIY Watch Kit - Blue Display Matrix*, ADAFRUIT, <http://www.adafruit.com/products/1225> (last visited Apr. 26, 2015).

82. E.g., *Oprah’s Favorite Things—2013 Edition!*, HUFF. POST (Nov. 5, 2013), http://www.huffingtonpost.com/2013/11/05/oprahs-favorite-things-2013_n_4218558.html (displaying a list of Oprah’s favorite products from 2013).

83. For a discussion of “dependent contractors,” see generally Elizabeth J. Kennedy, *Freedom from Independence: Collective Bargaining Rights for “Dependent Contractors,”* 26 BERKELEY J. EMP. LAB. 146, 150 (2005).

factory is that the maker produces items in collaboration with (or as a subcontractor to) a large corporation. In essence, we imagine corporate making.⁸⁴ Corporations have embraced the Maker Movement.⁸⁵ General Electric, for instance, has hosted “GE Garages,” makerspaces⁸⁶ that provide prototyping tools.⁸⁷ Corporations, including Intel,⁸⁸ have also purchased sponsorships to support “maker faires,” which are “family-friendly festival[s] of invention, creativity, and resourcefulness.”⁸⁹ Some makers-turned-company-founders have partnered directly with corporations. For example, Massimo Banzi, the creator of Arduino, which creates electronics kits, partnered with Radio Shack in 2012, which in turn sold Arduino products.⁹⁰ Arduino kits allow makers to build creative projects using electronic components.

84. David Rotman, *The Difference Between Makers and Manufacturers*, MIT TECH. REV. (Jan. 2, 2013), <http://www.technologyreview.com/review/508821/the-difference-between-makers-and-manufacturers/>. Rotman discusses author of *Makers: The New Industrial Revolution*, Chris Anderson:

[Anderson] has little interest in how things are actually manufactured. He locates the real value of the subculture in the creation and sharing of digital designs for stuff. Anderson is agnostic about what should happen next: send the design to your 3-D printer or upload it to the cloud and send it to a manufacturer in China, he suggests.

Id. Rotman also notes that scattered in the Maker Movement are “many clever ideas about sharing, collaborating, and creating consumer—friendly [sic] designs that could help revitalize our thinking about how to produce things.” *Id.* Finally, he points out that: “But to get anywhere near Anderson’s lofty goal of revolutionizing industry, individual makers and small startups will have to collaborate not only with each other but also with large industrial firms.” *Id.*

85. Reena Jana, *The Maker Movement Meets Big Business: Can the Indie-Minded Tinkers Get Comfortable in the Corporate World?*, COLO. MAKER HUB (July 27, 2014), <http://coloradomakerhub.org/2014/07/27/the-maker-movement-meets-big-business/>; see John Hagel, John Seely Brown & Duleesha Kulasooriya, *A Movement in the Making*, DELOITTE UNIV. PRESS, <http://dupress.com/articles/a-movement-in-the-making/> (last visited Apr. 26, 2015) (Deloitte is encouraging its corporate clients to “[e]mbrace the [maker] movement. Help shape its direction, and use it as a canvas to learn the contours of the world to come.”).

86. *Id.*

87. *Id.*

88. *Maker Faire Sponsorship*, MAKER FAIRE, <http://makerfaire.com/sponsors/> (last visited Apr. 26, 2015). Even the U.S. government is getting involved. See, e.g., Tina Casey, *When the Military Meets the Maker Movement*, TRIPLE PUNDIT (May 30, 2012), <http://www.triplepundit.com/2012/05/darpa-meets-techshop-oreilly-maker-movement/>.

89. *A Bit of History*, MAKER FAIRE, <http://makerfaire.com/makerfairehistory/> (last visited Apr. 26, 2015). “Maker Faire is the Greatest Show (and Tell) on Earth—a family-friendly festival of invention, creativity and resourcefulness, and a celebration of the Maker movement.” *Id.* At the most recent Maker Faire, hosted by the White House, President Obama articulated a common question to the maker habit of placing an “E” at the end of “faire.” He explained, “I mean, I wasn’t sure—is there jousting? Do we all have to get dressed up, or what? So I’m just warning you—next year, the “E” may be gone. I don’t know exactly who came up with that. This is America—we don’t have E’s at the end of ‘fair.’” President Barack Obama, *supra* note 11.

90. Jana, *supra* note 85.

Corporate partnerships with makers have some upsides, especially because corporations have the power to call attention to the Maker Movement and reach more people and resources.⁹¹ However, corporate-maker collaborations have downsides too. For example, corporations might appropriate the fresh, hip vibe of the Maker Movement, dilute it, and weave it into branding.⁹² It is possible that greenwashing (when a company, government, or other group promotes green-based environmental initiatives but actually operates in ways that are damaging to the environment)⁹³ could morph into makewashing.⁹⁴

More importantly, it is possible that Type III makers could become fronts for large corporations,⁹⁵ providing the opportunity for corporations to move work into homes, where both regulation and collective action are difficult.⁹⁶ Imagine, for example, that a big-box retailer like Wal-Mart or Costco decides to manufacture trendy, maker-inspired chairs called “Fabseats” using 3D printers.⁹⁷ While the retailer markets the Fabseats as unique creations crafted by individual makers from Austin to Portland, it realizes over time that it can make the chairs more cheaply by using immigrant labor in cities like El Monte, California.⁹⁸ In this context, home-based factories could recreate historical systems of homework,⁹⁹ and modern day home-based

91. *Id.*

92. *See id.* (comparing the corporate embracing of the maker movement to corporate appropriation of graffiti).

93. Greenwashing can also include misleading customers about the environmental benefits of a product through misleading advertising and unsubstantiated claims. *Greenwashing*, INVESTOPEDIA, <http://www.investopedia.com/terms/g/greenwashing.asp> (last visited Apr. 26, 2015).

94. This is the authors’ term. The Maker Movement could follow the same path as the corporate social responsibility movement, e.g., that many companies will jump on the bandwagon, even when their intent is more about profit making than about the Maker Movement.

95. Sadowski & Manson, *supra* note 49.

96. *See, e.g.*, LINDA BURNHAM & NIK THEODORE, HOME ECONOMICS: THE INVISIBLE AND UNREGULATED WORLD OF DOMESTIC WORK 5, 10–12 (2012) (noting that isolation and exemption from many core workplace legal protections has created significant barriers to workplace justice for workers like nannies, housekeepers, and home health aides who work within private homes).

97. *See, e.g.*, Alan Gardner, *Need a Chair? Now You Can 3D Print One at Home Thanks to Joris Laarman*, 3DPRINT.COM (May 16, 2014), <http://3dprint.com/3882/3d-printed-chair-laarman/>.

98. *See supra* note 48 and accompanying text.

99. This historical record here is important. Regarding homework in the early to mid-1900s, it is important to note the difficulties organized labor had when attempting bring work back from homes to factories. Organized labor unions—most notably Samuel Gompers and the Cigar Makers’ International Union (“CMIU”)—mounted several unsuccessful legislative campaigns against the shifting of work from brick-and-mortar factories to tenement kitchens and living

sweatshops could become a reality.¹⁰⁰

II. HARNESSING MODES OF SOCIAL CONTROL IN THE HOME-BASED FACTORY

No matter whether a home-based factory is a Type I, II, or III enterprise, traditional workplace laws will not be sufficient to prevent labor abuses in these workplaces of tomorrow. This Article relies on Professor Edwin M. Epstein's work in "The Good Company: Rhetoric or Reality? Corporate Social Responsibility and Business Ethics Redux"¹⁰¹ to explore how a broad range of social controls can be used to shape and moderate home-based factories as they respond to contemporary forces like globalization¹⁰² and technological revolutions, in order to create the most socially desirable workplaces.¹⁰³

rooms. DAVID BRIAN ROBERTSON, *CAPITAL, LABOR, AND STATE: THE BATTLE FOR AMERICAN LABOR MARKETS FROM THE CIVIL WAR TO THE NEW DEAL* 49 (2000). After decades of pitched labor battles, CMIU workers, and the union's continued existence was threatened by the proliferation of largely immigrant, non-union, family production teams working out of their homes. *Id.* The CMIU petitioned the New York City health commissioner to shut down the tenement factories. *Id.* After losing that campaign, they lobbied for a tax on tenement production, which also failed. *Id.* A state ban on tenement labor in New York City was eventually passed, but it was drafted so narrowly that industry employers simply shifted production to homes in Brooklyn (then an independent city) and Long Island, and was later struck down by the New York Court of Appeals. *Id.* Ultimately, the CMIU was forced to abandon their legislative approach. *Id.* Gompers recalls that:

Through our trade unions we harassed the manufacturers by strikes and agitation until they were convinced that . . . it would be less costly for them to abandon the tenement manufacturing system and carry on the industry in factories under decent conditions. Thus we accomplished through economic power what we had failed to achieve through legislation.

Id. at 50 (citing SAMUEL GOMPERS, *SEVENTY YEARS OF LIFE AND LABOR* 62 (Nick Salvatore ed., 1984)). Not until 1949 did a federal ban by Congress make industrial homework illegal by permitting the Department of Labor to regulate it. *See* 29 U.S.C. § 211(d) (2012) ("[The Department of Labor] is authorized to make such regulations and orders regulating, restricting, or prohibiting industrial homework as are necessary or appropriate to prevent the circumvention or evasion of and to safeguard the minimum wage rate prescribed in this chapter . . .").

100. For information about sweatshops in the global market, see Yossi Dahan, Hanna Lerner & Faina Milman-Sivan, *Global Justice, Labor Standards and Responsibility*, 12 *THEORETICAL INQ. L.* 117, 117 (2011) ("We propose four principles to guide the allocation of responsibility for remedying the unjust conditions of workers in the world, based on measures of . . . contribution . . .").

101. Epstein, *supra* note 19. Epstein stated that TNCs "are key players in this changing dynamic as utilizers and transfer agents of the physical, human, financial, and intellectual resources of our global society. As such, through their policies, processes, and practices, they play an important role in facilitating global peace or exacerbating global conflict." *Id.* at 209–10.

102. Epstein defines globalization as "[t]he advent of a truly worldwide trading regime made possible by modern communications and transportation technologies . . ." *Id.* at 208.

103. For Epstein, technological revolutions like in the hi-tech and biotech industries "have

Epstein describes six modes or factors of social control that “individually and in combination, are critical to achieving socially responsible corporate behavior.”¹⁰⁴ First, Epstein describes law, which “derives from state action (legislation, judicial decisions, regulatory rulings, and promulgations by other public bodies) and articulates public policy enforced by governmental authority.”¹⁰⁵ Second, he describes standards of behavior created by affinity groups.¹⁰⁶ He highlights professional bodies that govern professions such as law, medicine, and accounting, which license, regulate, and control each discipline through professional codes.¹⁰⁷ Third, Epstein describes self-regulation as “voluntary acceptance of standards established by nongovernmental entities . . . or pertaining to particular issues such as child labor . . . , third-world apparel manufacturing, fair trade coffee, [and] green environmental policies”¹⁰⁸ Fourth, he explains that ethical precepts, which are “derived from religious traditions, humanistic philosophy, customs, mores, and traditions,” guide people toward the right action, both individually and in organizational settings.¹⁰⁹ Fifth, Epstein describes how vigilant and responsible media holds corporations accountable by seeking information and raising questions about questionable behavior.¹¹⁰ Finally, he presents civil society as a mode of social control.¹¹¹ He explains how informed, engaged citizens encourage positive organizational and corporate behavior by pressuring government actors to correct inappropriate behavior.¹¹²

We use these six modes of social control to analyze how working conditions in home-based factories might take shape, using the following individualist and collective approaches.

radically altered our global political economy.” *Id.* at 209.

104. *Id.* at 212.

105. *Id.* at 210.

106. *Id.* at 210–11.

107. *Id.* at 211. The professions regulated by mandatory membership in professional bodies include health care, realtors, architects, and securities dealers. *Id.*

108. *Id.* Examples of entity-created standards include the Sullivan Principles and Caux Round-table’s Statement of Principles.

109. *Id.*

110. *Id.* at 212.

111. *Id.*

112. *Id.*

A. Individualistic Approaches

“Good people do good things to the benefit of all.”¹¹³

Sweatshop labor is defined by the characteristics of the job.¹¹⁴ Workplace conditions arise from a combination of economic and social forces. The Feminist Majority Foundation¹¹⁵ describes sweatshop employers as those who “violate two or more labor laws, from the prohibition of child labor, to health, safety, fire, and building codes, to forced overtime and the minimum wage.”¹¹⁶ For individualistic thinkers, employers and employees engage in a voluntary exchange of labor for wages,¹¹⁷ and markets, as opposed to laws, will punish employers who create sweatshops.¹¹⁸ For example, when consumers learn that a product was made using sweatshop labor, individualists presume that those consumers will vote with their dollars, and take their business to a more socially responsible seller. If society relies on markets to control behavior in Type I, II, and III home-based factories, the mode of social control most likely to inspire positive behavior is that of ethical precepts. This is because ethical precepts, such as virtue,¹¹⁹ may guide individual organizational corporate leaders and their followers in ways that support cardinal virtues,¹²⁰ especially fairness.¹²¹

1. Ethical Precepts

Virtue theory is an ethical theory that focuses on the individual.¹²² Each person engages in discernment around this question: “What sort of person must I become to be able to do the right thing?”¹²³ This theory is rooted in Aristotelian philosophy.¹²⁴ Aristotle “recognized that excellent products and services cannot be produced from a foundation

113. Ronald J. Colombo, *Toward a Nexus of Virtue*, 69 WASH. & LEE L. REV. 3, 84 (2012).

114. Miller, *supra* note 22, at 95.

115. See *Feminists Against Sweatshops*, FEMINIST MAJORITY FOUND., <http://www.feminist.org/other/sweatshops> (last visited Apr. 26, 2015) (gathering data regarding women working in sweatshops around the globe).

116. Miller, *supra* note 22, at 96.

117. See Browne & Meuti, *supra* note 56, at 365.

118. *Id.*

119. Kennedy, *supra* note 21, at 14–15; see Colombo, *supra* note 113, at 3–4 (arguing that a focus on virtue is more likely than regulatory reform to prevent the next financial crisis).

120. Kennedy, *supra* note 21, at 14–15.

121. *Id.*

122. *Id.*

123. *Id.*

124. *Id.*

of mediocrity, frustration, fear, and moral poverty.”¹²⁵ He highlighted virtues, which are good habits¹²⁶ that direct action toward a middle ground.¹²⁷ Virtuous actors avoid extremes.¹²⁸ Additionally, they have a “firm and settled disposition to choose the good.”¹²⁹

Virtuous actors rely on four specific virtues to support their work: courage,¹³⁰ discipline,¹³¹ wisdom, and fairness. Wisdom and fairness are especially relevant in the context of leadership as they inspire in-home work. Wisdom is “the habit of recognizing good ends and choosing effective and efficient means of achieving them.”¹³² Fairness, or justice, is “the habit of giving to others what they are due.”¹³³ Leaders who embrace both the Maker Movement and virtue theory will recognize that “good ends” imply respect for employees. Moreover, the virtue of fairness requires that leaders treat employees well because giving workers their due means giving them fair wages and safe workplaces.

As home-based workplaces grow, virtuous leaders must create a culture that weaves ethical behavior throughout the entire operation. As Dr. Leslie Sekerka has pointed out, an organization’s leader can cultivate ethical behavior in a number of ways.¹³⁴ For example, the leader can conduct ethics audits¹³⁵ to make sure managers have responded to particular ethical dilemmas in ways consistent with the virtues of wisdom and fairness. The leader can also connect ethical strength to the organization’s mission.¹³⁶ The leader can embed principles of fairness into the organization’s foundation, and structure operations around a concept of shared value.¹³⁷

125. *Id.* at 14.

126. *Id.* at 15.

127. *Id.*

128. *Id.*

129. *Id.*

130. *Id.* at 13. “Courage is the habit moderating the emotions of fear or boldness to achieve a rational goal.” *Id.*

131. *Id.* Discipline is “the habit of moderating the emotions of enjoyment and denial to achieve a well-ordered personal or professional life.” *Id.*

132. *Id.* at 14.

133. *Id.*

134. Leslie E. Sekerka, *Compliance as a Subtle Precursor to Ethical Corrosion: A Strength-Based Approach as a Way Forward*, 12 WYO. L. REV. 277, 299 (2012) (providing recommendations for leaders about how to promote organizational ethical strength and emphasize professional moral courage).

135. *Id.*

136. *Id.*

137. As Porter and Kramer explain, “[s]hared value is not social responsibility, philanthropy

The drawback in using ethical precepts to guard against labor abuses is that individual makers may honestly believe they are operating in ways that promote justice, freedom, and virtue, when such practices nevertheless exploit their workers.¹³⁸ Likewise, this individualistic approach has the potential to overlook critical issues of gender and power that have historically underscored the debate between “women’s right to work [at home]” and “women’s right to be protected under the law from unfair labor practices [at home].”¹³⁹ Just as nannies, housekeepers, and elder care providers have often been excluded from traditional workplace protections based on gendered devaluation of their work,¹⁴⁰ so too may the work of knitters, crafters and other makers be discounted as not “real work,” and therefore not deserving of formal legal protections.

For example, Etsy’s own publications and marketing materials include testimonials of women whose Etsy shops enable them to have it all, based on a very-very small business model, which conjures images of women-run “micro-enterprises” and systems of “micro-finance” in developing nations.¹⁴¹ This would appear consistent with the virtues of fairness, opportunity, and equality. However, such a business model may be predicated on the overwhelming absence of supports for women

or even sustainability, but a new way to achieve economic success.” Porter & Kramer, *supra* note 62, at 64.

138. For example, Bonny Dutton is the owner of Fleece on Earth, a children’s apparel business run out of her barn. She paid local retirees, whom she regarded as “independent contractors,” to knit baby bonnets and sweaters, which she sold online. A state investigation concluded that the retirees were in fact employees, and that Bonny Dutton owed back unemployment insurance and penalties. For Bonny, treating the workers as independent contractors allowed her to keep the work local, a point of pride and extension of her own ethical norms and integrity. If she had to treat her workers as employees, she might move production to China. Patricia B. Gray, *Is She Being Fleeced?*, FORTUNE SMALL BUS., Apr. 1, 2006, available at http://money.cnn.com/magazines/fsb/fsb_archive/2006/04/01/8373106/.

139. Eileen Boris, *Homework and Women’s Rights: The Case of the Vermont Knitters, 1980–1985*, 13 SIGNS 98, 116 (1987).

140. *Id.*

141. ETSY, REDEFINING ENTREPRENEURSHIP, *supra* note 33, at 4. The report includes testimonials like:

“While working full time from home, I’m able to earn the same income that I did outside of the home, and I also have the flexible schedule, reduced stress, and sense of achievement that comes with being my own boss. As my husband and I are expecting our first child in a few months, I am more thankful for Etsy than ever before. I will be able to contribute to our family’s bills and savings, but also have the freedom to arrange my schedule so that I can be present with my family. The beauty of selling on Etsy is that I can take a day or weekend away from working, and my items are still online, being seen and purchased by buyers all over the world.”

Id. (quoting Etsy user Melissa Grice).

and families, such as paid maternity leave and affordable child-care. Moreover, despite a global perception that such micro-enterprises “hold the key to satisfying work, higher income, and a more balanced intersection between work and home,” most women-run micro-enterprises actually “fail to produce the financial and psychological transformations women were anticipating.”¹⁴² This raises questions about whether 3D printing and the Maker Movement can sustain micro-enterprise opportunities for women marginalized by the traditional manufacturing economy, or whether it will merely “repackage old, failed ideas about microenterprise and women,”¹⁴³ and contribute to the creation of “Etsy sweatshops.”¹⁴⁴

This echoes a similar debate that took place in the 1980s, as Congress considered lifting the ban on industrial homework, which was originally put into place as a result of rampant abuses of women and children as tenement sweatshop workers at the turn of the last century. Proponents of ending the ban, many of whom were not known for feminist politics, framed it as a “‘women’s issue.’”¹⁴⁵ The Heritage Foundation argued that a ban on homework “‘would be a serious blow to thousands of women seeking financial independence.’”¹⁴⁶ Senator Orrin Hatch (R-Utah), introduced legislation to lift the ban with the stated goal of helping mothers “‘achieve[] economic self-sufficiency’” by allowing them to earn money at home (a scenario attractive perhaps only because they lacked affordable child care or paid maternity leave).¹⁴⁷ In the rhetoric of the deregulators,¹⁴⁸ homework stood for “independence,”

142. MATCHAR, *supra* note 68. After studying the allure of microenterprise in the United States over fifteen years ago, anthropologist Tracy Bachrach Ehlers concluded:

The promise of microenterprise has been communicated to the public through a deluge of uplifting Horatio Alger-like success stories about women-owned, largely home-based, businesses. In what could be deemed a microenterprise crusade, the public landscape has been saturated with a vast array of self-help articles, books, videos and television programs promoting microenterprise. The message is that microenterprise holds the key to satisfying work, higher income, and a more balanced intersection between work and home.

Id. at 92–93 (footnote omitted).

143. MATCHAR, *supra* note 68, at 93.

144. Etsy has already come under fire for enabling overseas manufacturers to sell “handmade” items that, in all likelihood, were handmade under sweatshop conditions or mass-produced. See, e.g., CALLIN’ OUT ON ETSY, <https://etsycallout.wordpress.com> (last visited Apr. 26, 2015) (hosting a website hosted by a self-described “vigilante flagger” that allows Etsy users to “call out” Etsy sellers whose items for sale violate the “handcrafted” mission of Etsy).

145. Boris, *supra* note 139, at 100 (citation omitted).

146. *Id.* at 237 (citation omitted).

147. *Id.* (citation omitted).

and the ability of women to work from home while simultaneously caring for their small children was a “right.”¹⁴⁹

Opponents of lifting the ban, however, included the International Ladies Garment Workers’ Union, which predicted a return to home-based sweatshops in the textile industry.¹⁵⁰ Undocumented workers, many of whom evoked an earlier generation of immigrant women in the artificial flower and textile industries, testified to living “close to the edge of survival; [claiming that] internalized clocks, set by low piece-rates, push them on.”¹⁵¹ To alleviate the cost of living, one woman was forced to purchase her sewing machine because she was “‘a mother with children without a husband’ . . . though it took her two to three hours to sew a dress for which she received \$1.30.”¹⁵² Once again, children were being used to perform the labor: “You have sort of a deadline, and the child is brought in.”¹⁵³ As we think about the potential for abuses in home-based factories powered not by sewing machines, but by 3D printers, we must recognize that individual ethical precepts may be insufficient to counter the economic realities that continue to threaten women’s right to workers’ protections under the law from unfair labor practices at home.

2. Self-Regulation and Affinity Group Standards

Two additional individualistic modes of social control can also support ethical, home-based factories: self-regulation and affinity-group standards. Self-regulation presumes that those inside an organization—such as its workers—are better situated to detect, report, and avoid abuse than government regulators and law enforcement.¹⁵⁴ Using self-

148. This group was surprisingly diverse, including a group of fiercely independent female Vermont knitters. Rushworth M. Kidder, *The Flap Over the Cottage-Industry Ban*, CHRISTIAN SCI. MONITOR, (Dec. 12, 1983), <http://www.csmonitor.com/1983/1212/121207.html>. One such knitter, Mary Clement, explained, “I am tired of the antiquated idea that women must be taken care of.” Boris, *supra* note 139, at 113.

149. *Id.*

150. *Id.* at 111.

151. *Id.* at 115.

152. *Id.* (citation omitted).

153. *Id.* (citation omitted).

154. CYNTHIA ESTLUND, *REGOVERNING THE WORKPLACE: FROM SELF-REGULATION TO CO-REGULATION* 17–18 (2010). According to Estlund,

[T]he more sophisticated proponents of corporate self-regulation—particularly those who have gathered under the broad umbrella of “New Governance”—argue not for the abandonment of public regulation of corporate conduct but for its redeployment: external law should be designed to encourage employers to internalize public values and regulate their own practices rather than serving primarily as a direct instrument of control. In other words, the law should not merely step aside in favor of voluntary self-

regulation to ensure workplace fairness involves “an intricate, almost unconscious, network of voluntary control and standards among *workers and employers* themselves, and [is] enforced by *both parties* themselves.”¹⁵⁵ One way that organizations engage in self-regulation is by voluntarily adopting and adhering to standards that nongovernment agencies create.¹⁵⁶ These standards can be formal, such as the International Labor Organization’s (“ILO”) standards for “decent work for domestic workers.”¹⁵⁷

Standards can also be informal. One form of informal standards is social audits.¹⁵⁸ Internal social audits, however, may be limited in curbing abuses in the context of home-based factories, which are, by definition, removed from public oversight. In essence, self-regulation in these workplaces may amount to nothing more than a thinly disguised form of “self-deregulation.”¹⁵⁹ However, the Maker Movement, based as it is on principles of democracy and justice, could bolster individual modes of self-governance by creating larger affinity groups that shape the Movement through a professional code of conduct.¹⁶⁰ The Movement must anticipate possible abuses in Type I, II, and III home-based factories and place on their agenda discussion and action with regard to child labor, wage, work-hour, and safety issues. A

regulation; it should regulate self-regulation.

Id. at 15.

155. DAVID WEIL, *THE FISSURED WORKPLACE: WHY WORK BECAME SO BAD FOR SO MANY AND WHAT CAN BE DONE TO IMPROVE IT* 266 (2014) (rephrasing JANE JACOBS, *THE DEATH AND LIFE OF GREAT AMERICAN CITIES* (1961)). Looking at contemporary workplace regulation through a socio-historic lens of Jane Jacobs, Weil adapts a Jacobs quote to read:

The first thing to understand is that *workplace fairness—the day-to-day fair and equitable treatment of working people, abiding by the laws of the land*—is not kept primarily by *government inspectors*, necessary as *those inspectors* are. It is kept primarily by an intricate, almost unconscious, network of voluntary control and standards among *workers and employers* themselves, and enforced by *both parties* themselves. In some *workplaces—nonunion, gloves-off workplaces* with very high *employee* turnover are often conspicuous examples—the keeping of *workplace fairness* is left almost entirely to the *government*. Such places are jungles. No amount of *inspectors* can enforce civilization where the normal, casual enforcement of it has broken down.

Id.

156. Epstein, *supra* note 19, at 211.

157. See, e.g., ILO Convention (No. 189) Convention Concerning Decent Work for Domestic Workers art. 6, Geneva, Jun. 16, 2011 (entered into force Sept. 5, 2013).

158. Epstein, *supra* note 19, at 211.

159. ESTLUND, *supra* note 154, at 137.

160. The challenge here would be linking actions to the Maker Movement’s emphasis on freedom.

movement that already has a Bill of Rights and two manifestos¹⁶¹ can surely create a professional code to make sure that small shop¹⁶² philosophy is consistent with justice and workers' interests. With regard to Type III factories, the Maker Movement must expect that some corporations will hide behind maker ideals, while acting in ways that are inconsistent with transparency and accountability. However, affinity groups in these industries are well positioned to harness cyber technology to create virtual spaces and communication platforms with which to electronically monitor workplace conditions, share information, and report allegations of abuse. In essence, the Maker Movement can enforce a self-created professional code, and guard against actors who fail to live up to the movement's ideals.

B. Collective Approaches

*“Now, craft and DIY reappear as political acts, reclaiming the personal and communal in a neoliberal capitalist system that has separated effort, affect and creativity from production.”*¹⁶³

Some hackers, a subset of makers, are “fiercely political, technically sophisticated, highly venturesome and on the move—people who are all too ready to talk about institutions and political change.”¹⁶⁴ For these

161. See Morozov, *supra* note 2.

162. The idea of the small business is a significant part of the American dream. Eyal-Cohen, *supra* note 43, at 1 (“This article argues that many small business programs today are locked in due to heavy investment by our legal system that outweighs any advantages from possible change.”).

163. Powell, *supra* note 57.

164. David Bollier, *Morozov on the Maker Movement*, BOLLIER.ORG (Jan. 27, 2014, 2:42 PM), <http://bollier.org/blog/morozov-maker-movement>. Bollier argues that Evgeny Morozov “does a nice job exposing the sly propagandizing of Chris Anderson, Kevin Kelly, and Stewart Brand. These are among the leading tech gurus who rhapsodize about the coming era of individual freedom and progressive social change that 3D printing, fablabs and hackerspaces are ushering in.” He further argues:

While there will always be market-oriented boosters like Chris Anderson and Kevin Kelly, they are easy foils for Morozov....even straw men. The hackerspace world has its own voice, apart from such celebrity commentators. Why not give a platform to these on-the-ground, politically committed activists, hackers, academics and project participants? I find that there is a lot of talk in these circles about policy and institutions—and about taking pro-active steps to protect the hacker ethic.

...

It's easy for [Morozov] to let Anderson, Kelly and Brand serve as spokesmen for the hacker world and then reveal the corporate partners lurking nearby. But it doesn't take much looking to discover that there is also a corps of hackers out there who are fiercely political, technically sophisticated, highly venturesome and on the move—

left-leaning makers, the idea that a maker-inspired company could turn into a sweatshop is abhorrent. But, as critical thinkers, they recognize that it is not implausible. Followers of feminist critical theory, for example, recognize the connections between “*not just the personal [and] the political, but the critical [and] the creative.*”¹⁶⁵ Collective modes of social control are therefore necessary to guard against potential abuses within home-based factories.

1. Law

Law, as a mode of social control, must be leveraged to ensure that working conditions in home-based factories are fair and just; that the process of creating is as reflective of “maker values” as the final product. Law, to collectivists, must apply equally in the context of private homes as it does in brick-and-mortar factories, a proposition that is complicated because traditional theories about the nature of the employment relationship “presuppose[] a world in which workers leave the confines of their private homes and travel to public workplaces.”¹⁶⁶ So what, then, when the confines of a private home is the workplace? The eventual rise of the home-based factory will blur the boundaries between public and private, between home and market, and between family and work. In response, traditional workplace laws must adapt to the changing need for, and implementation of, workplace regulation and enforcement regimes. Three areas of law are especially important: wage-and-hour law, child-labor law, and health-and-safety law.¹⁶⁷

Enacted over seventy-five years ago, the fundamental purpose of the Fair Labor Standards Act (“FLSA”)¹⁶⁸ remains the same today: to establish minimum standards of living by requiring a “‘fair day’s pay for a fair day’s work.’”¹⁶⁹ The FLSA requires covered employers to

people who are all too ready to talk about institutions and political change.

Id.

165. Red Chidgey, *Developing Communities of Resistance? Maker Pedagogies, Do-It-Yourself Feminism, and DIY Citizenship*, in *DIY CITIZENSHIP*, *supra* note 8, at 101, 105 (footnote omitted).

166. Peggie R. Smith, *Aging and Caring in the Home: Regulating Paid Domesticity in the Twenty-First Century*, 92 *IOWA L. REV.* 1835, 1841 (2007).

167. King, *supra* note 11. There is also an environmental agenda. Moreover, with regard to labor, issues of workers’ compensation and social security may arise.

168. 29 U.S.C. §§ 201–219 (2012).

169. Jonathan Grossman, *Fair Labor Standards Act of 1938: Maximum Struggle for a Minimum Wage*, <http://www.dol.gov/dol/aboutdol/history/flsa1938.htm#21> (last visited Apr. 26, 2015) (quoting Franklin Delano Roosevelt, Message to Congress on Establishing Minimum Wages and Maximum Hours (May 24, 1937), in 7 *PUBLIC PAPERS AND ADDRESSES OF FRANKLIN D. ROOSEVELT* 209 (Random House, 1937)). Grossman went on to quote Roosevelt at

pay minimum and overtime wages to any employees it “suffer[s] or permit[s] to work,”¹⁷⁰ including those engaged in “industrial homework” or “piecework.”¹⁷¹ While the fundamental purpose of the law remains intact, the economy in which the law is applied has changed dramatically.¹⁷²

length:

On May 24, 1937, President Roosevelt sent the bill to Congress with a message that America should be able to give “all our able-bodied working men and women a fair day’s pay for a fair day’s work.” He continued: “A self-supporting and self-respecting democracy can plead no justification for the existence of child labor, no economic reason for chiseling worker’s wages or stretching workers’ hours.” Though States had the right to set standards within their own borders, he said, goods produced under “conditions that do not meet rudimentary standards of decency should be regarded as contraband and ought not to be allowed to pollute the channels of interstate trade.” He asked Congress to pass applicable legislation” [sic] at this session.

Id.

170. U.S. DEP’T OF LABOR, FACT SHEET # 13: EMPLOYMENT RELATIONSHIP UNDER THE FAIR LABOR STANDARDS ACT 1 (revised May 2014), *available at* www.dol.gov/whd/regs/compliance/whdfs13.pdf. The FLSA applies to homeworkers who are covered on an “individual” basis or whose employer is covered on an “enterprise” basis. The enterprise coverage test requires a specified annual dollar volume of business. However, in most instances, a homeworker is covered under the FLSA on the basis of individual coverage (i.e., production of goods for out of state shipment and/or receipt of out of state materials or goods used in the production process). *Id.*; *see* *Goldberg v. Whitaker House Coop., Inc.*, 366 U.S. 28, 31–32 (1961) (explaining that homeworkers who were members of a cooperative were employees for purposes of the FLSA); *McComb v. Homeworkers’ Handicraft Coop.*, 176 F.2d 633, 637 (4th Cir. 1949) (explaining that homeworkers were employees covered by the FLSA). The law also includes recordkeeping, reporting, and equal-pay obligations.

171. Under the FLSA, industrial homework (also called “piecework”) means the production of goods for an employer in a home, apartment, or residential room regardless of whether the employer supplies the raw materials. 29 C.F.R. § 530.1(d) (2014). Covered employers are required to pay homeworkers at least the minimum wage, regardless of whether the wage is calculated by time, piece, job, incentive, or any other basis. 29 C.F.R. § 530.202(b) (2014). If the cost of tools, tool repair, or similar requirements are borne by the worker, such costs may not lower the wages paid below the minimum wage or reduce the wages owed for overtime hours. 29 C.F.R. § 531.35 (2014). When employing homeworkers, employers must also provide workers with homeworker handbooks to record their time, business-related expenses (e.g., equipment and supplies), and pay information. 29 C.F.R. §§ 516.31(b)–(c) (2014). All employees who have been hired since November of 1986 must also fill out the I-9 form, required by INS. As for all employees covered by the FLSA, overtime must be paid at one and one-half times the employee’s regular rate of pay for each hour worked “in excess of forty hours in any workweek.” 29 U.S.C. § 207 (2012). The regular rate includes all remuneration for employment, such as piece rate earnings and commissions paid. *Id.* Time and one-half of the average piece rate of pay is to be paid for hours worked over forty per week, if the average is greater than the employee’s regular rate of pay (never less than the required minimum wage). *Id.*

172. WEIL, *supra* note 155, at 266. Evoking a nineteenth-century regulatory landscape concerned with tenement sweatshops, the FLSA prohibits the manufacture of certain types of products within private homes, such as women’s apparel, knitted gloves and mittens, buttons and buckles, handkerchiefs, and embroideries and jewelry, but there is no general prohibition against industrial homework. U.S. DEP’T OF LABOR, FACT SHEET # 24: HOMEWORKERS UNDER THE

Home-based factories of any type could easily run afoul of the FLSA if they fail to pay minimum wages for piece rate work, especially when the cost of a 3D printer, materials, and maintenance end up cutting into the amount of wages these workers actually earn. Given the rapidly changing technology, employers may also fail to count training time, preparation and cleanup activities as time spent working. They may also violate the FLSA by treating employees as independent contractors¹⁷³ or by failing to maintain required records.¹⁷⁴

While a vast technological divide separates the piecework sewing of mittens in the twentieth century from the 3D printing of a prosthetic hand in the twenty-first, the opportunities for wage-and-hour violations (as well as the barriers to monitoring such violations within a private home¹⁷⁵) are virtually identical. Critical to the success of using law as mode of social control in the home-based workplace will be education

FAIR LABOR STANDARDS ACT (revised Jul. 2008), <http://www.dol.gov/whd/regs/compliance/whdfs24.htm>. In certain cases, these goods may be produced within a private home provided the manufacturer receives prior certification from the U.S. Department of Labor. *Id.* Specifically,

Certification occurs when the employer obtains an employer certificate, or homeworkers obtain individual certification, from the Department's Wage and Hour Division, authorizing such work. Certified employers of homeworkers in these industries will be required to renew their certificate every two years. Employer certification is not available for women's apparel and certain hazardous jewelry manufacturing operations; only individual certification is permitted.

Id.

173. *See, e.g.,* *Fleece on Earth v. Dep't. of Emp't & Training*, 923 A.2d 81, 594 (Md. 2007) (finding that knitters and sewers were not free from the company's control or direction over performance of services, and thus, services constituted "employment."). The U.S. Department of Labor has concluded that "[p]eople who perform work at their own home are often improperly considered as independent contractors. The [FLSA] covers such homeworkers as employees and they are entitled to all benefits of the law." U.S. DEP'T OF LABOR, FACT SHEET # 13: EMPLOYMENT RELATIONSHIP UNDER THE FAIR LABOR STANDARDS ACT (FLSA) (revised Jul. 2009), <http://www.uvm.edu/newfarmer/business/whdfs13.pdf>. The U.S. Department of Labor has promulgated regulations to enforce the FLSA with regard to homeworkers; however, the regulations are limited to industrial homeworkers. Press Release, Bureau of Labor Statistics, *Work at Home in 2004* (Sept. 22, 2005), *available at* <http://www.bls.gov/news.release/pdf/homey.pdf>. According to the regulations, industrial homework "means the production . . . of goods for an employer who suffers or permits such production . . ." 29 C.F.R. § 516.31(a)(2). The definition of employment as "suffer[ing] or permit[ing] production" reinforces the economic reality test and only applies to goods. *Id.* Telecommuters, who are most likely to provide services and not produce goods, are not covered.

174. *See supra* note 171 and accompanying text (discussing requirements pursuant to the FLSA).

175. Compare the experience of domestic workers, like nannies, housekeepers, and caregivers for the elderly and disabled. *E.g.,* Elizabeth J. Kennedy, *When the Shop Floor is in the Living Room: Toward a Domestic Employment Relationship Theory*, 67 N.Y.U. ANN. SURV. AM. L. 643, 655-59 (2012).

and enforcement strategies that recognize the particular challenges of workplaces within private homes. Particularly useful will be the many state and local initiatives used to combat wage theft and other workplace abuse in the domestic work industry.¹⁷⁶

In addition to the challenges of monitoring and enforcing wage-and-hour laws, preventing the use of child labor in home-based factories will be difficult, if not impossible. Fourteen is the minimum age required for most non-agricultural work, with restrictions tailored to the relative danger of a particular job or industry.¹⁷⁷ At sixteen or seventeen, workers may perform any non-hazardous job,¹⁷⁸ and fourteen- and fifteen-year-olds may work in non-manufacturing, non-hazardous jobs. However, at any age, children may deliver newspapers, babysit, perform on television, or work in businesses owned by their parents.¹⁷⁹ With respect to home-based factories, therefore, the law needs to respond quickly to determine whether or not the use of 3D printers in residential homes qualifies as “manufacturing” or “hazardous.” If, in fact, the toxic chemicals used to print 3D products do qualify as hazardous, the Department of Labor should educate the maker community and corporations utilizing home-based piecework systems that no one under the age of eighteen may be permitted to work at home using 3D-printing technology.

Moreover, the federal Occupational Safety and Health Act (“OSHA”) requires that employers provide workplaces “free from recognized hazards that are causing or are likely to cause death or serious physical harm”¹⁸⁰ Workers who labor in their own homes as employees are covered only while they are actually working for pay, and injuries or illnesses covered by OSHA must be directly related to that work, rather than a general home environment or setting.¹⁸¹ If a worker using a 3D printer is burned by molten plastic when the nozzle misfires, that injury would likely be reportable under OSHA. On the other hand, if the

176. *Id.*

177. U.S. DEP’T OF LABOR, FACT SHEET #43: YOUTH EMPLOYMENT PROVISIONS OF THE FAIR LABOR STANDARDS ACT FOR NONAGRICULTURAL OCCUPATIONS (Jul. 2010), <http://www.dol.gov/whd/regs/compliance/whdfs43.pdf>. Regulations governing youth employment in non-agricultural jobs differ somewhat from those pertaining to agricultural employment. *Id.*

178. Workers eighteen years or older may perform any job, whether hazardous or not. *Id.*

179. Also, curiously, at any age, youth may be employed as homeworkers to gather evergreens and make evergreen wreaths. U.S. Dep’t of Labor, *Youth Rules: Frequently Asked Questions*, <http://www.youthrules.dol.gov/know-the-limits/faq/index.htm> (last visited Apr. 26, 2015).

180. 29 U.S.C. § 654(a)(1) (2012).

181. 29 C.F.R. § 1904.5(b)(7) (2014).

printer causes a fatal fire due to faulty wiring in the home, that may not.¹⁸² In response to technological advances that enabled more workers to “telecommute” in the 1990s, OSHA issued a “pilot program”¹⁸³ on regulating home offices, causing uproar in the popular press.¹⁸⁴ It then issued a formal directive¹⁸⁵ stating that it will not inspect home offices for safety and health violations, but it distinguished between white-collar telecommuters and blue-collar industrial homeworkers.¹⁸⁶ While it “respects the privacy of the home” for telecommuters, it will conduct inspections of home manufacturing operations when it receives a complaint¹⁸⁷ or referral that indicates that a violation of a safety or health standard exists that threatens physical harm, or that an imminent danger exists, including reports of a work-related fatality.¹⁸⁸ In practice, OSHA has investigated only two home worksites and both of those investigations involved lead contamination.¹⁸⁹

Home-based factory employers may be more likely to have minimal or nonexistent safety or health training, leaving workers using 3D printers vulnerable to exposure to toxic chemicals and other health risks related to poorly maintained workplaces, including poor ventilation.¹⁹⁰ As the Maker Movement grows, employees and employers need to be

182. Stone, *supra* note 47, at 273 (footnote omitted).

183. Kelli L. Dutrow, Comment, *Working at Home at Your Own Risk: Employer Liability for Teleworkers under the Occupational Safety and Health Act of 1970*, 18 GA. ST. U. L. REV. 955, 990, 992 (2002).

184. Frank Swoboda & Kirstin Downey Grimsley, *OSHA Covers At-Home Workers*, WASH. POST, Jan. 4, 2000, at A01, <http://www.washingtonpost.com/wp-srv/WPcap/2000-01/04/053r-010400-idx.html>.

185. U.S. DEP’T OF LABOR, OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION, OSHA DIRECTIVE CPL 2-0.125 HOME-BASED WORKSITES (2000), https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=2254 [hereinafter OSHA, HOME-BASED WORKSITES].

186. See Nicole Belson Goluboff, *Workplace Safety and the Telecommuter*, TRIAL MAG., June 2002, at 37.

187. OSHA, HOME-BASED WORKSITES, *supra* note 185. (“Examples of such work from OSHA’s past inspections include: assembly of electronics; casting lead head jigs for fishing lures; use of unguarded crimping machines; and handling adhesives without protective gloves.”)

188. *Id.*

189. Joan T. A. Gabel & Nancy Mansfield, *On the Increasing Presence of Remote Employees: An Analysis of the Internet’s Impact on Employment Law as it Relates to Teleworkers*, 2001 U. ILL. J.L. TECH. & POL’Y 233, 263 (2001). In 2000, two bills were proposed in Congress regarding OSHA coverage of homeworkers. *Id.* at 264. One proposal would have removed white-collar home offices from the OSH Administration’s jurisdiction and the other would have removed all home worksites. *Id.* Both bills languished in subcommittee. *Id.*

190. See OSHA, HOME-BASED WORKSITES, *supra* note 185 (explaining different hazards to which home-based factory workers may be exposed).

equipped with knowledge about OSHA standards, potential workplace hazards related to 3D printing and related manufacturing processes, as well as clear guidance and user-friendly mechanisms for filing OSHA complaints.

2. Vigilant and Responsible Media and Direct Action

Although law anchors social control from a collectivist perspective, two additional modes can establish and sustain just working conditions in home-based factories: vigilant and responsible media, and direct citizen action.¹⁹¹ Today, we rely on television, radio, newspapers, and the Internet to call our attention to businesses engaged in questionable practices.¹⁹² We rely also on citizens to engage and pressure the government to act, or corporate actors to change course, when they see something going wrong.¹⁹³ In the age of “new media,”¹⁹⁴ these two modes of social control are often intertwined, as citizen activists use blogs, Twitter, Facebook, and similar social media platforms to broadcast, or “call out” corporate misconduct.¹⁹⁵ Given the technological dexterity and progressive ideologies embraced by many members of the Maker Movement, these modes of social control offer great promise for collectively establishing and enforcing just working conditions in home-based factories.

As a recent example, activists took to the Internet after learning that the Gap refused to sign on to the Bangladesh Accord on Fire and

191. Epstein, *supra* note 19, at 212.

192. See, e.g., Chen, *supra* note 17 (discussing investigative reporting of the unjust labor conditions for New York City artisanal and craft food workers); Anna Palmer & Robin Bravender, *New Corporate Foe: The Shame Lobby*, POLITICO (May 16, 2012, 11:42 PM), <http://www.politico.com/news/stories/0512/76425.html> (detailing how consumer advocacy groups and individual activists are forcing corporations to change their business practices—often rapidly—using free social-media tools like Twitter, Facebook, and Change.org).

193. See, e.g., BRANDWORKERS & URBAN JUSTICE CTR., FEEDING NEW YORK: CHALLENGES AND OPPORTUNITIES FOR WORKERS IN NEW YORK CITY’S FOOD MANUFACTURING INDUSTRY 10 (2014) (documenting hazardous working conditions and widespread disregard for basic labor protections in New York City’s food manufacturing industry); Angus Loten, *New Tool in Trademark Fights*, WALL ST. J., Feb. 23, 2012, at B.5, <http://online.wsj.com/news/articles/SB10001424052970203358704577237473534179392> (explaining that small startups are using social media to shame large corporations that overreach with intellectual property rights to shut down competitors); Bailey Socha & Barbara Eber-Schmid, *What is New Media? Defining New Media Isn’t Easy*, NEW MEDIA INST., <http://www.newmedia.org/what-is-new-media.html> (last visited Apr. 26, 2015).

194. See Socha & Eber-Schmid, *supra* note 193 (“[N]ew media enable[s] the average person to engage in political, cultural, social, and economic action Perhaps the potential of new media is a function of its intermediate development and our social, political, and economic transition within and outside of it.”).

195. Palmer & Bravender, *supra* note 192.

Building Safety, which established more rigorous international labor standards in the wake of a devastating series of garment factory fires in 2013.¹⁹⁶ In addition to the “petition, social media share and then deliver model of online campaigning,”¹⁹⁷ labor activists employed more creative, counter-hegemonic tactics. Posing as the Gap’s P.R. department, an organization of predominately first-generation and immigrant Asian-Americans, “18 Million Rising,”¹⁹⁸ launched “an impeccably designed fake website”¹⁹⁹ called Gapdoesmore.com, and released a statement timed with the company’s shareholder meeting, announcing that Gap had indeed signed on to the Accord.²⁰⁰ Other activists have had similar success with these types of disruptive media hoaxes.²⁰¹ As the organizer of the “Gap Does More” hoax explained:

The relationship to what we do online and what we do in our communities, locally or in real life — as if the Internet is not real life — is complex. It requires a deeper analysis of how technology is integrated into our lives and the way in which media can shape public perceptions of things.²⁰²

In the future, it is likely that social media will evolve in ways that promote improved corporate behavior. Citizens, including makers, are now media savvy, and can use social media to further the common good, especially just workplaces.

CONCLUSION

3D printing is a significant technological breakthrough that is changing how we make things, and is projected to do so in

196. Isabelle Nastasia, *Meet the Organizer Who Pulled Off the Gap Does More Hoax*, WAGING NONVIOLENCE (May 24, 2014), <http://wagingnonviolence.org/2014/05/pulled-gap-hoax/>. Instead of signing the accord, a legally binding agreement drafted and ratified by Bangladeshi labor unions, factory owners, and European and American brands, the Gap created its own “Bangladesh Alliance for Worker Safety,” comprising the Gap and Wal-Mart. *Id.*

197. *Id.*

198. Gapdoesmore.com resembled the official website, with logos for Gap Inc.-owned Banana Republic, Old Navy, Piperlime, and Athleta on the top. Jule Balise, *Hoax Website Urges Gap to “do more than sell clothes,”* SFGATE (May 21, 2014, 10:37 AM), blog.sfgate.com/techchron/2014/05/21/hoax-website-urges-gap-to-do-more-than-sell-clothes/.

199. Nastasia, *supra* note 196.

200. *Id.*

201. See, e.g., Michael Walsh, *Feminist Group Leaves Consent-Themed Panties in Victoria’s Secret Stores to Protest ‘Culture of Rape’ and Company Themes it Finds Problematic*, N.Y. DAILY NEWS, Dec. 16, 2012, (explaining how activists Rebecca Nagle and Hannah Broncato and other members of the organization Force: Upsetting Rape Culture launched a fake website (“Pink Loves Consent”) and dropped consent-themed underwear in more than a dozen Victoria’s Secret stores to protest the “culture of rape” it believes the company promotes).

202. Nastasia, *supra* note 196.

exponentially diverse and far-reaching ways.²⁰³ Before new patterns of production develop fully, and before in-home factories take shape, we have an opportunity to consider how modes of social control can intersect with innovation in ways that yield socially desirable outcomes. If the Maker Movement inspires small startups, we want virtuous leaders to embrace ethical standards that ensure fairness for workers and the larger society. If virtuous leaders monitor themselves, and inspire fellow makers to do the same, the Maker Movement holds great promise. When makers collaborate with large corporations, the opportunities for socially desirable outcomes might grow exponentially, but so will challenges. Legal scholars and practitioners must be ready to intervene to shore up any market weaknesses that arise, such as the possibility that new work will create issues surrounding fair wages and hours, child labor, and safety. The media and individual citizens must be on the lookout for problems and seek opportunities to redirect organizational and corporate activity. By observing and acting, we can ensure that 3D printing—a disruptive technology²⁰⁴—will disrupt in ways that work for everyone. This debate should be viewed “as a prelude to a larger struggle over the shape and control of the American workplace.”²⁰⁵ We look forward to celebrating a new era of creativity, one that promotes new ways of making, and new commitments to fairness.

203. World demand for 3D printing is projected to rise more than twenty percent per year to \$5 billion in 2017. *World 3D Printing to 2017*, REPORTSNREPORTS (Dec. 2013), <http://www.reportsnreports.com/reports/272154-world-3d-printing-to-2017.html> (last visited Apr. 26, 2015). Much of the growth in 3D printing from 2014–2020 is expected to come from the healthcare and aerospace industries. *3D Printing Materials Market by Plastics (Photopolymers, ABS, PLA, Nylon, & Others), by Metals (Steel, Silver, Aluminum & Others), by Ceramics (Silica, Glass, Quarts & Others), by Others (Wax, Laywood & Others), by Forms, by End-User Industries and by Region – Global Trends & Forecasts to 2019*, MARKETS & MARKETS (Nov. 2014), <http://www.marketsandmarkets.com/Market-Reports/3d-printing-materials-market-1295.html>.

204. Harvard Business School professor Clayton M. Christensen uses the term “disruptive technology” to describe a new technology that unexpectedly displaces an established technology. CLAYTON M. CHRISTENSEN, *THE INNOVATOR’S DILEMMA: THE REVOLUTIONARY BOOK THAT WILL CHANGE THE WAY YOU DO BUSINESS* xviii (1997). Christensen separates new technology into two categories—sustaining and disruptive.

205. Boris, *supra* note 139, at 120.