

At-Home 3D Printing & the Return of a Craft Utopia

“The Web was just the proof of concept. Now the revolution hits the real world.” (Anderson 1) With these words Chris Anderson, editor of Wired magazine joins Makerbot and RepRap creators and countless breathless bloggers in heralding the dawn of a technology that promises to bring to bear the same force that upturned media industries to manufacturing industries. This technology is desktop 3D printing which uses 3D object files to build up an object through the deposition of layers of raw material.



fig. 1: Bre Pettis and The Replicator by Makerbot Industries

It works on the same principles as a desktop paper printer, though instead of ink it prints plastic, ceramic slip, and other tactile materials. It is made accessible by the effect of open-source parts, plans and tutorials and priced low enough to make at-home factories a possibility for the avid hacker. Object files are shared the way music and other “old media” forms are shared: as information. The tools of industrial design seem tantalizingly close, open to all. Given that object data is easily exchanged, edited and endlessly vast, the potential for revolution seems only logical. The manufacturing industry is destabilized and individuals regain an agency lost since the first industrial revolution.

We have heard these claims many times before. An especially interesting corollary can be found in the utopian project of craft-idealists like William Morris. A connection between other underground and utopian-minded maker cultures seems a natural entry point given the language of DIY and craft that often surrounds discussions of at-home prototyping. Since at least the 1st industrial revolution the word craft has been relegated to nostalgia, luxury goods or kitsch but as Malcolm McCullough asks in his book *Abstracting Craft: The Practised Digital Hand*, "...can we, here in the computer age, with fully optimistic and benevolent intent, suggest that the word needs a more inclusive definition?" (McCullough 21) Rather he premises craft as a verb that "remains skilled work applied toward practical ends." Even Morris, usually described as strictly anti-machine deserves a re-reading for how he saw the machine in terms of idealized craft production. Morris called for machinery as a "help to the workman's hand-labor and not a supplanter of it" (ed. Adamson 150). Also, "...machines of the most ingenious and best-approved kinds will be used when necessary, but will be used simply to save human labor" (Morris 22).



fig. 2: William Morris

His argument was not against machinery per-se but against the dehumanizing effect of its industrial position via divisions of labor where "goods are made apart from the life of those who use them". One might assume that in society's push for ever more advanced technology that craft was marginalized and forsaken. But as Tanya Harrod describes in "Paradise Postponed: William Morris in the 20th Century", the breakup was mutual. Post-Morris crafters such as Bernard Leach and Michael Cardew ascribed to a conception of "craft" as something more isolated from the machine than anything that Morris advocated. While the definition of craft was becoming more narrow, technology became marginalized in the increasingly rarified realm of "Craft". As Neri Oxman describes in "Digital Craft, Fabrication-Based Design in the Age of Digital Production", technology and craft share an origin in the concept of *techné* (Greek for craft). Oxman defines *techné* as "the rational method involved in producing an object", a definition that eliminates the constructed difference between so-called advanced technologies and tactical forms of production (Oxman 1). Morris also called for a more nuanced conception of the machine's place in relation to hand work. He wondered "Will the period of machinery evolve itself into a fresh period of machinery more independent of human labor than anything we can conceive of now, or will it develop its contradictory shape of a new and improved period of production by handicraft? (Morris 150) " This latter premise might seem to foretell the resurgence of interest in DIY and craft in our age of digitized community, where the ubiquity of the machine creates a desire for the hand. But the expansion of craft to the digital realm does not rely on linguistic deconstruction. It manifests in innumerable blogs and websites, such as instructables.com, makezine.com, dedicated to small-scale and unique production and modification. Equating hand-craft with digital-craft is more than a pedantic exercise. By looking at this "Next Industrial Revolution" through the lens of past calls for utopian craft we can examine the critical potential of this technology at the outset. It turns out we have a lot to learn from the results of past calls for a new industrial revolution.

In "Atoms are the New Bits" Wired magazine editor Chris Anderson suggests that with the rise of decentralized modes of production "Everybody's garage is a potential high tech factory."(Anderson 8) For Bre Pettis, the face of Makerbot Industries which fabricates open source 3D printers for purchase, the possibility of toppling paternalistic systems of manufacture with hacker pluck and ingenuity is key. "Its absurd that we need a revolution to bring personally fabricated objects to the marketplace. We are humans with hands.... Somehow the first industrial revolution took that away from us." (Pettis 1) Adrian Bowyer who leads the team that developed RepRap, a self-replicating 3D printer has an equally idealistic end-point in mind for RepRap though tempered with a bit of pragmatism uncommon for discussions of revolution. He allows "Most research projects do not lead to world-changing products and it would be hubris to imagine the RepRap would be any different." (Bowyer 6) That he says this at all indicates he is in fact aware of the revolutionary potential (and the audacity of what he's suggesting). Instead he proposes RepRap as "Darwinian Marxism". "Darwinian" because the machine is made to self-replicate and rapidly evolve in the open source habitat, "Marxism" because the maker/worker will gain control of the means of production, as Bowyer says, "without all that messy and dangerous revolution stuff."



fig. 3: RepRap self-replicating 3D printer with original and copy.

William Morris also called for this type of gentleman's revolution. A prominent Marxist, he posited the "Revival of Handicraft" as the path to the liberation of the worker from dehumanizing divisions of labor in industrial work. He sees the revival of handicraft as a "token of the change which is transforming civilization into socialism". (ed. Adamson 150) This focus on makers shaping culture is no less than what many proponents envision as open source hardware follows the route of open source software. Past maker revolutions relied on state control and violent revolution but the most profound check to industry now may be open source and decentralized manufacture.

What we have learned from past calls for utopian design should give us pause. Perhaps one of the most instructive lessons of William Morris' Arts and Crafts movement is how easily the force of capitalism subsumed any vestige of revolutionary power. As Harrod describes, "Morris as a sound businessman, kept practice and philosophy separate apparently believing that only after a full-blooded revolution would it be possible for a new art to develop" (Harrod 7) This focus on commodity production before idealistic models have only increased since Morris. Indeed as Harrod points out, "The practitioners of the crafts have gradually shed their utopian ambitions as they have come to occupy a small but acknowledged niche in the world of goods". (Harrod 23) This might be seen to corollate with the subsumption of the revolutionary-minded DIY movement into the world of the market via sites like etsy.com.



fig. 4: Etsy.com

While this decentralization of the marketplace may itself be seen as revolutionary it must be remembered that early proponents of the current DIY ethos saw it as a critique of the capitalist system of which etsy.com plays a part. As Dennis Stevens describes in "DIY: Revolution 3.0- Beta" in *American Craft* magazine, "It is important to acknowledge that DIY craft as a movement emerged as part of community activism, with a lineage that can be traced back to the 1980s and the punk movement, 'zine activity and into the early 1990s with the Riot Grrrl movement." While citing this critical lineage Stevens continues with a justification of its use of commerce as critical statement. He states, "Rather than bringing revolution to the front door and kicking it open... these independent makers are using the disarming and unassuming aesthetic of diy craft's domestic creativity to make subversive statements about the world in which we live." (Stevens 2) This leads one to wonder, is irony a reasonable replacement for revolution? This uncritical acceptance of capitalist models wrapped in revolutionary language is perhaps most pronounced in Chris Anderson's "Atoms are the New Bits". In it he describes his vision of an "age of democratized industry, (where) every garage is a potential micro-factory, every citizen a micro-entrepreneur." Anderson is surprisingly transparent about the routes he suggests such citizen industrialists should take: outsourcing. He describes outsourcing as one of the main innovations he sees available to decentralized production for the first time. As he says, "Anybody with an idea and a little expertise can set assembly lines in China into motion with nothing more than some keystrokes on their laptop." (Anderson 11) In outsourcing to China the actual implementation of this revolution falls prey to the same complicity to dubious labour and ecologic standards that centralized industry is responsible for. Individual manufacturing capacity thus necessitates individual responsibility for ethical action. If as Chris DiBona, Open Source Programs Manager at Google describes "Think of RepRap as a China on your desktop", it is now each maker's responsibility to demand open source production doesn't result in sweat shop labor. Asking individual makers to take into account the ethical impact of their goods production may seem in some ways as difficult as it is to make multi-national corporations budge. The drive toward economic growth at any cost seems insatiable. But there are other more intractable limits to adopting an Industrial model. As Adrian Bowyer alludes to in his description of Reprap's large-scale adoption, "Of course, any exponential growth must run up against resource limits...." (Bowyer 8)

In his shattering 2010 book *Eaarth* Bill McKibben makes plain that economic growth as we've known it is coming to an end. We have thoroughly exhausted the limits of the systems that support our civilization and we must change. Not that we *should* change, but that we don't have a choice anymore.

As this next industrial revolution is in its infancy it must take this reality into account if it will be at all successful. According to McKibben this is no longer about utopian idealism or consumer revolutionaries, this is the sober reality.

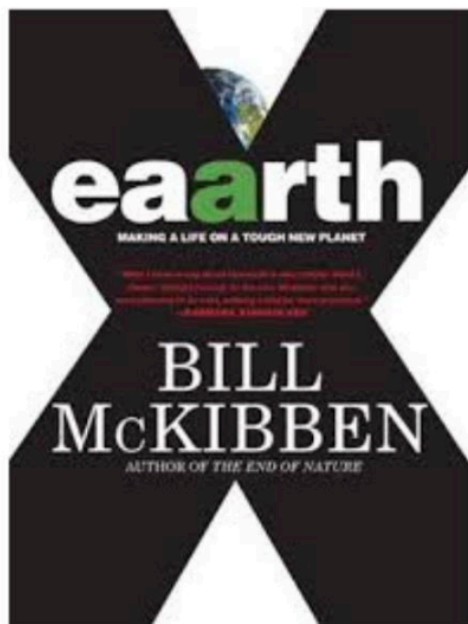


fig. 5: Bill McKibben's *Eaarth*

Interestingly in McKibben's view of our possible futures the decentralization of services, such that Bowyer and Pettis predict, will be key. He states, "We'll need, chief among all things, to get smaller and less centralized, to focus not on growth but on maintenance."(McKibben 204) Citing the vulnerability of centralized industries and watching as more and more fail, McKibben looks to local agriculture and energy production as essential to adapting to new conditions. E.F. Schumacher in his 1973 book *Small is Beautiful* shares a similar prognosis to *Eaarth*, saying "super-technology of the modern world, acts like a foreign body, and there are now numerous sings of rejection."(Schumacher 156) Schumacher also seems to anticipate decentralized manufacture when he says "the poor of the world cannot be helped by mass production, only by production of the masses." (Schumacher 163) Schumacher ties decentralized production to both sustainability and Morrisian attitudes on machinery saying, "The technology of *production by the masses*, making use of the best of modern knowledge and experience is conducive to decentralization, compatible with the laws of ecology, gentle in its use of scarce resources, and designed to serve the human person instead of making him the servant of machines." Even Morris in *Factory Work, As It Is and Might Be* shared this focus on adopting ecological standards as integral to a re-imagined industry, "...our factory must make no sordid litter, befoul no water, nor poison the air with smoke."(Morris 16) even going so far as to cite "Earth, the Common Mother" (Morris 13) as a material source. Morris' *News From Nowhere*, an idealized imagining of Utopia, describes a society where decentralized craft production has developed an ecologically sustainable system where London is replaced by fields and gardens (Levitas 107). While for Morris this idealized London results from socialist revolution it is becoming the reality of cities such as Detroit who are already coping with the failures of industry by turning the overgrown remnants of demolished neighborhoods, known as urban prairies into small farms.

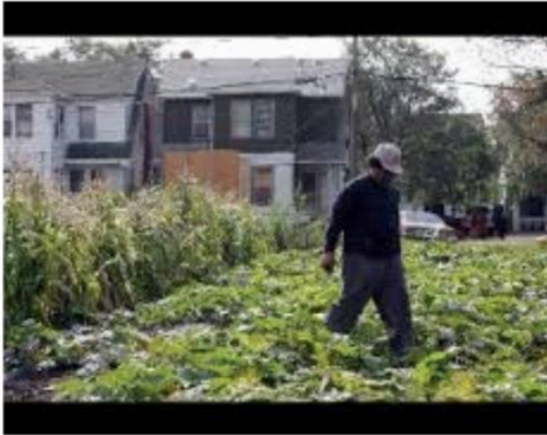
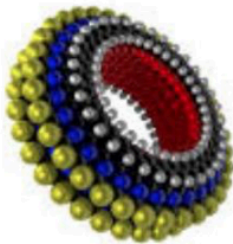


fig. 6: "Urban Prairie" Farming, Detroit

McKibben anticipates this re-evaluation of local resources as an increasingly necessary response. The proliferation of plastic parts that one now sees on 3D print file sharing sites like thingiverse.com exemplifies an unfortunate reliance on un-sustainable petrol-based materials. Encouragingly this is a limitation signaled by some key 3D printer developers themselves. Adrian Bowyer indicates that though now RepRap uses a polyester the intention is to switch to a fermented starch-based material where the biomass can be grown locally and the fermenter would be made by the RepRap, "Thus not only would the machine be self-replicating, so would its material supply." Taking into account the entire life cycle of the RepRap and its goods Bowyer notes that they are "investigating the possibility that a RepRap machine could make its own recycler." This echoes the premise of cradle-to-cradle (C2C) design methods which suggests the full life-cycle of a product should be taken into account in the preliminary conception of any design. This 2nd industrial revolution will only be revolutionary, indeed will only exist, if it deals head on with our ecologic crisis and makes the development of ecologically sustainable materials use a reality. If anything can do this perhaps the evolution of technologies via open source models on the Internet has a chance.

McKibben after describing the complete breakdown of every form of human industry shares this optimism of the internet as viable option, suggesting that the it may offer solutions that centralized cultural production can not. In fact, he notes that the decentralization of information sharing via the Internet “will be crucial, because all of a sudden we need vast amounts of information”, where “If you have a question, there are a thousand people you can quickly figure out how to ask.” Perhaps this is what may allow 3D printing to find sustainable innovations where centralized industry remains deadlocked. One especially promising avenue for sustainable 3D printing innovation is seen in the Kartik M. Gada Humanitarian Innovation prize offered by the Foresight institute.



THE FORESIGHT INSTITUTE

fig. 7: The Foresight Institute

It calls on communities of developers to co-create 3D printing innovations using an open source model that will make decentralized manufacture possible for the poorest nations. It goes even further by calling on the participants to develop these projects “to be helpful in recycling material waste (such as plastics) into material suitable for RepRap use.” The juries intentions are that “All technology developed by participating teams becomes open source”. Interestingly even Morris shared this aspiration for an open model of production where “Competition being dead and buried, no new process, no detail of improvements in machinery, would be hidden from the first inquirer.” (Morris 26) Rafael Cardoso in his 2008 essay “Craft versus Design, moving beyond a tired dichotomy” explicitly links this earlier craft idealism to current developments where “designers have begun to revive the old lessons of collective authorship and creative commons, sharing with colleagues, intermediaries and users the responsibilities of making things work.” (ed. Adamson 331) While the ideal results of an open innovation of ethical and ecological 3D printing models are still speculative the decentralization of manufacture and skill-sharing precedes it. In some ways the decentralized industrial revolution that Bowyer and Pettis link to 3D printing prefaced that single innovation. The evidence can be found at instructables.com and makezine.com but also sites like openfarmtech.org and localharvest.org.



fig. 8: Afrigadget.com

One especially interesting example is found at afrigadget.com dedicated to “solving everyday problems with african ingenuity.” The site showcases such things as a plastic recycling press that transforms plastic waste into useful sheeting, lamps made from repurposed scrap and anerobic digesters to produce methane gas.

Distributed forms of manufacture offers the possibility of a globally connected locally minded and cooperative skill-sharing that can move the innovation of micro-manufacturing from entrepreneurial enterprise to a progressive re-imagination of what may still be possible in the material world. This 2nd industrial revolution may succeed where others have failed simply because it may be the most viable option in the failure of outmoded models of centralized industry. Paradoxically, it is industry that brought itself down by its abuse of power, resources, and labor; rather than by the emergence of a collective utopia. Perhaps the collective and pragmatic idealism that is exhibited by latter-day William Morris who continue to strive for alternatives to centralized industry offers a way to a more hopeful future. The use of decentralized industry to model avenues through the detritus of the 1st industrial revolution may be its most progressive possibility. It now falls to the 3D modelers of thingiverse.com and other object file innovators to link their creations to this broader movement. If not they risk becoming a revolution cut short: just another source of plastic trinkets with an insular gee-whiz focus on what is effectively child’s play in contrast to the magician’s toolbox they may now have their hands on.

Bibliography

Adamson, Glenn ed. *The Craft Reader*. Oxford: Berg, 2010

Anderson, Chris. "In the Next Industrial Revolution, Atoms Are the New Bits." *Wired* 25 January 2010. 28 April 2010 <http://www.wired.com/magazine/2010/01/ff_newrevolution/>.

Bowyer, Adrian. "Philosophy Page." RepRapWiki 21 July 2006. 5 May 2010 <<http://reprap.org/wiki/PhilosophyPage>>.

Cardoso, Rafael. "Craft versus Design: Moving Beyond a Tired Dichotomy." *The Craft Reader*. Ed. Glenn Adamson. Oxford: Berg, 2010. 321-332.

Harrod, Tanya. "Paradise Postponed: William Morris in the 20th Century." *William Morris Revisited*. Ed. Jennifer Harris. London: Birmingham Museum and Art Gallery, 1996. 6-32.

Johnson, Joel. "Atoms Are Not Bits; *Wired* is Not a Business Magazine." *Gizmodo*. 26 January 2010. <<http://gizmodo.com/5457461/atoms-are-not-bits-wired-is-not-a-business-magazine>>

Levitas, Ruth. *The Concept of Utopia*. Hertfordshire: Syracuse University Press, 1990.

Marx, Karl. "Capital." *The Craft Reader*. Ed. Glenn Adamson. Oxford: Berg, 2010. 69-77.

McCullough, Malcolm. *Abstracting Craft: The Practiced Digital Hand*. Cambridge: The MIT Press, 1996.

McKibben, Bill. *Eaarth*. New York: Henry Holt & Company. 2010

McLaren, Graham. "Reviewed work(s): Abstracting Craft: The Practiced Digital Hand by Malcolm". *Journal of Design History* Vol. 11, No.1. 1998: 102-103.

Morris, William. *Factory Work As It Is and Might Be*. New York: New York Labor News Co., 1922

Noble, Richard ed. *Utopia: Documents of Contemporary Art*. Cambridge: The MIT Press, 2009.

Pettis, Bre. "Industrial Revolution 2." Bre Pettis Blog 24 Sept. 2009. 20 May 2010.

<<http://www.brepettis.com/blog/2009/9/24/industrial-revolution-2.html>>

Schumacher, E.F.. *Small is Beautiful, Economics as if People Mattered*. London: Blond & Briggs Ltd., 1973

Stern, Becky. "The Revolution Will Be Squirted." *Make*: Vol.21 2010: 46.

Stevens, Dennis, "DIY: Revolution 3.0-Beta." *American Craft* Oct/Nov 2009. 25 May 2010

<<http://www.americancraftmag.org/article.php?id=8837>>.