

Reconstituting the Utopian Vision of Making: HCI After Technosolutionism

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ABSTRACT

HCI research has both endorsed “making” for its innovation and democratization capacity and critiqued its underlying technosolutionism, *i.e.*, the idea that technology provides solutions to complex social problems. This paper offers a reflexive-interventionist approach that simultaneously takes seriously the critiques of making’s claims as technosolutionist while also embracing its utopian project as worth reconstituting in broader sociopolitical terms. It applies anthropological theory of the global and feminist-utopianism to the analysis of findings from research on making cultures in Taiwan and China. More specifically, the paper provides ethnographic snippets of utopian glimmers in order to speculatively imagine and explore alternative futures of making worth pursuing, and in so doing reconstitute the utopian vision of making.

Author Keywords

Making; maker movement; DIY; innovation; neoliberalism; capitalism; utopianism; policy; HCI; China; Taiwan.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

In recent years, a collection of emerging technologies and practices has co-evolved into what is now often referred to as “making,” or “the maker movement.” Hailed in the media as *the* contemporary site of technological innovation and as a revamp of economies and broken educational systems, making is promoted as having diverse potential benefits for society. What was largely understood as a hobbyist movement, associated with the early hackerspaces in the 1990s in Europe and the founding of Arduino in 2006 [20], has over the last 10 years transformed into an aspiring interdisciplinary arena of social computing [2,10,48].

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Making is often articulated in utopian terms; it is envisioned to democratize technology production. Through the transformation of the self, empowered by the tools of production, making will have broad social, economic, and political impacts, so the story as portrayed by advocates of the maker movement often goes, *e.g.*, [3]. This largely utopian vision of making has already had impact as the growing number of investments in maker-related activities, projects, events, and spaces evidence [19, 48]. The rapid transformation of making from the fringes to the mainstream has been in part enabled by the financial and/or political support of large corporations including Intel, Qualcomm, Microsoft, Ford; by educational institutions ranging from local libraries to American ivy league universities; and by city and national governmental entities including but not limited to the US White House, the US National Science Foundation, the Chinese national and local city governments, Singapore, the Taipei city government and “creative industry policy” bureau, the European Union, and many more.

The HCI research community has shared this enthusiasm and expressed diverse interests in making. These include an interest in making as a new domain of computing [32,42, 48,60,77], which HCI can investigate to theorize interaction, to pursue new design methodologies, and to which HCI can contribute tools and infrastructure [7,14,16,21,35, 40,41,43,44,54,68,76]. HCI researchers have also explored the potentials of making to contribute towards a sustainable IT agenda [61]. One of the central interests that these diverse projects share is making’s contribution to the democratization of technology use and design. For instance, making is envisioned to move IT innovation out of university and corporate labs into everyday society [29,71]. Making is also seen as enabling marginalized groups to participate in computing innovation, including children [26,34], women [28,64] and people in the Global South [18].

At the same time, HCI research has also expressed skepticism towards some of these projects, suggesting that they are unrealistic or even naïve [1,2,10,25,28,37,39,47,60,61, 62,69,74]. This research suggests that there is a technosolutionism underlying making and much of the research on the topic. Technosolutionism is the view that technology can unilaterally solve difficult social problems. Technosolutionism is visible in promotions of making that portray it as furthering sustainability, social justice for women, economic development for the Global South, and empowerment for all. HCI research has also problematized

this view as it largely rests on the deployment of Western conceptions of democracy and empowerment to characterize what is in fact a global phenomenon [17,37,39,40,46,47,47,69].

Taken together, the utopian vision of making has been unmasked as resting on a kind of technosolutionism and ideological colonialism, in a literature of critical studies in and beyond HCI that is hard to dismiss. Yet, the body of critical HCI scholarship on making has not replaced the technoutopian vision with an equally aspirational vision. Thus, HCI researchers are in a dilemma. We can pursue making as an avenue to increase participation and democracy in technology use and design, if we take what has been criticized as a naïve technosolutionist stance. Or we can take a critical stance and thereby risk abdicating our agency in contributing towards making's sociopolitical potentials.

This paper seeks to deconstruct this dilemma and to explore a way of pursuing making research that robustly pursues a democratizing agenda, while remaining technically, critically, and empirically sophisticated. We argue that a methodological blind spot has made it hard for HCI to pursue technical and sociopolitical agendas simultaneously: common methodological stances tend to prioritize either the possibilities of technical innovations or careful sociopolitical critique—but not both equally and at the same time. This is not to suggest a rigid binary between the utopian project of make and its critics. Rather, we acknowledge that both share a commitment to critical intervention and change, although each construes change and intervention differently. For instance, the utopian project of making is also a form of critique; it challenges perceived conceptions of computing and design (and who gets to do them), as is visible, for instance, in Leah Buechley's work [14,15,16]; and making's project to democratize production is positioned to disrupt passive consumer culture, *e.g.*, [71]. Similarly, critical scholarship is also committed to a form of intervention. We propose to reconstitute the utopian vision of making to harmonize the interventionist and utopian impulses of the technical and critical agendas.

Reconstituting the Utopian Vision of Making

We ask: how can we blend the contributions of technologists who are opening up making to new uses and users with the contributions of more critical voices to pursue the democratization of making as an equally sociotechnical research practice? What is needed is both a technical and a sociopolitical perspective, because (obviously) democratization itself is a sociopolitical issue, implicated in problems of hegemony and structural disenfranchisement. Technological innovations, such as new tools and kits, may well have democratizing potential, but realizing that potential is not merely a technical problem; it is also a sociopolitical one.

To summarize, this paper offers an attempt to pursue making's democratizing potentials, by constructing and deploying a perspective that is equally fluent in, and equally prioritizes, technical and sociopolitical perspectives. We say

“attempt” because this project is bigger than any of us, let alone a single paper. Rather than seeing our contingent perspective as a reason to shy away from our sociopolitical agency as researchers, we see it instead as a place to start. Throughout, we strive to maintain a critical sensibility to prevent devolving into cheerleading and fad-ism.

To do so, we adopt the reflexive-interventionist approach of feminist utopianism [12] and speculative sociology [45] as developed by Shaowen Bardzell [6,8]. Specifically, we propose a double move to outline how HCI can begin such a reflexive-interventionist approach. The first move constitutes a *critique of the present* to reveal both problem spots and opportunities for intervention as well as practices, spaces or moments where alternatives to dominating modes are revealed. We deploy the concept of “global assemblages” in order to analyze making on both levels (technological and sociopolitical), without normalizing making in Western terms. The second move is rooted in our critique of the present; in it, we employ an *anticipatory design* approach to move forward. Anticipatory design is an approach from feminist philosophy and speculative sociology [6,8,12,45] that is reconstructive, working with fragments as raw materials out of which to speculatively imagine and explore alternative futures worth pursuing (which is what makes this activity “utopian”). Anticipatory design provides models and tactics to pursue ambitious social goals of making in a pragmatic and participative way.

In what follows, we provide a detailed explanation of the analytical commitments of each of these two moves. To articulate each, we draw from our extensive fieldwork on making in China and Taiwan. This includes many years of ethnographic research with diverse making cultures including but not limited to hobbyist makers, makerspaces, hardware entrepreneurs, policy makers, artists, designers, crafters, manufacturers, and more. Details of our methods and long-term work are documented here: [6,7,9,46,47,48,61,74,79]. A central commitment in our ethnographic engagements in China and Taiwan has been the close collaboration with our interlocutors, including co-authorship and the hosting of workshops aimed at bringing together hands-on making with critical intervention. Throughout, we continuously reflect on our own positionality in relation to our fieldsites, as described in [9,10,47,49]. For purposes of clarity, we first tackle *critique of the present: making as global assemblages* and then turn to move 2 *anticipatory design: utopian glimmers of making*, with each section teasing out stories and aspects of making from our fieldwork as potential raw materials for a critique of the present and an anticipatory design practice. The written format forces a kind of sequencing, which does not mean to suggest that the two moves necessarily have to occur in the order presented here. On the contrary, the two moves work hand-in-hand, unfold alongside one another in and through our empirical and analytical work. The double move is aimed at articulating a sensibility (rather than a firm recipe) for future research on making in HCI and cultures of production more broadly.

The discussion brings the two moves together in order to reconstitute the utopian vision of making. Throughout this paper, we build on prior research on non-Western making [17,18,37,39,40,41,46,47,48,69,70,79] to continue decenter a predominantly Western narrative of making (and technology design writ large) by opening up alternatives and other possible futures.

MOVE 1: CRITIQUE OF THE PRESENT

Any critique of the present requires substantive empirical work informing us of the present. Reading and doing such empirical research critically implies taking seriously that making means different things across regions and is practiced in relation to situated technological and cultural processes, while acknowledging that at the same time making can not be divorced from global processes of capital flows, investments, geopolitical tensions, and so on. Prior research has emphasized that much of the techno-utopian idealism and visions of democratization are articulated from a largely Western perspective [17,69,70]. Reframing democratization of technology as a sociopolitical problem thus benefits from a decentering of this Western-centric perspective. We also need a theoretical perspective to account for making in its sociopolitical and technomaterial complexities. We draw from a body of work in global anthropology. Specifically, we use the concept of “global assemblages” [58], which refers to a conceptual approach to understanding and accounting for emerging “material, collective, and discursive relationships” that are articulated as global forms [58]. Examples of such forms, as collected in [58], include organ selling, bond trading, and DNA self-testing; to which list we would add making, as we explain in what follows below. These forms of life are global in the sense that they move across cultural situations (*e.g.*, stem cell research as a global practice), and yet they are also locally enacted and performed (*e.g.*, stem cell research in the US is legally and politically constrained in ways that such research is not elsewhere).

Key to this approach is the concept of “assemblage,” which according to [58] “is the product of multiple determinations that are not reducible to a single logic. The temporality of the assemblage is emergent.... As a composite concept, the term ‘global assemblage’ suggests inherent tensions: global implies broadly encompassing, seamless, and mobile; assemblage implies heterogeneous, contingent, unstable, partial, and situated” (12, emphasis in original). In summary, global assemblages are emergent and heterogeneously composed forms of life situated both in local and global practices, materials, and discourses. Such an understanding counters the abstract and structural notion of a global universal, replacing the latter with concrete little histories of situated forms of life as they participate in, are shaped by, and also do not relate to “the global.”

Making, we argue, is such a global assemblage. In other words, we do not see a single maker movement as a global universal with local instances. Rather, we examine in this

paper specific “ensembles of heterogeneous elements – the assemblages” [58] through which making and its significance is articulated and practiced. This becomes evident in the following two ways.

First, maker groups are spread across the globe, view themselves as part of a global movement, and articulate values and practices using global networks, from wikis to globally disseminated maker franchises such as FabLab. Part of this phenomenon is the dissemination of ideas (*e.g.*, “everyone can be a maker” and “making is a whole new paradigm of IT innovation”), which when widely disseminated, become global ideas that are interpreted and put into action in diverse ways in particular sites and situations.

Second, making is linked to global capital, though its flows are socially, institutionally, and technologically concentrated in contingent ways. For instance, making as start-up culture has in part proliferated because of new channels such as crowdfunding, which remains predominantly accessible to a fairly elite network of technologists [2, 19]. Making also can’t be divorced from broader “techno-capitalist” processes such as the utilization of (free) user participation and open innovation as business model, *e.g.*, companies that remained open source long enough to build up a robust product and user base and then switched to a proprietary model, *e.g.*, MakerBot and 3DRobotics [20,25,47]. Making is simultaneously a symptom and a transformation of global processes of capitalism: while making feeds off of existing structures of power, it is also aimed at and specifically motivated by democratizing technology production.

The “maker movement” is often presented as a global universal, applying equally to Silicon Valley, Taipei, Changsha, and Windhoek. Ong and Collier’s [58] approach to “global assemblages” provides a means to problematize such a view by investigating the “petit recits” of particular locales as these ideas come into contact with praxis. This approach reveals that global practices such as making do not fit under a single definition but are better understood as sharing family resemblances. In perceiving the resemblances, we can construct an account of the global form. But in perceiving the variations, which resist or fail to fit the unifying narrative, we can find alternative practices and potentials. In other words, viewing making as global assemblages gives us the methodological and epistemological tools to account for heterogeneous aspects of making without losing sight of the fact that they are all “making.” The global assemblages approach provides tools to expand prior research with a reflexive program for the study of global processes of technology, *e.g.*, [23,24,36,47,61,72,79], avoiding the binary between universals like globalization or innovation on the one hand and place-based struggles on the other. Instead, global assemblages replace the global universal with “petit recits” of situated forms of life through which the global is produced. We now continue by unpacking how the making practices we observed in China and Taiwan unfolded as global assemblages.

Making in China as Global Assemblages

Making as global assemblage in China figures in the following key ways: 1) aspirations to position making, and with it China, as a key site in global networks of technology innovation and on par with Western innovation hubs like Silicon Valley; and 2) a wave of entrepreneurs, who turn their maker visions into commercial products by engaging with manufacturing in the South of China. We now articulate how these two aspects of making as global assemblages come to the fore in China.

In 2012, China witnessed its first international maker event; the Maker Carnival. Since around 2010, a steadily growing number of open source hardware enthusiasts had come together across a variety of Chinese cities. They had opened up maker and hackerspaces, organized local workshops and events, and written about their open source hardware projects online. The 2012 Maker Carnival was intended not only to bring together makers from various places in China, but also to help legitimize and generate visibility for their efforts in international maker circles. The organizers, a group of makers in China, considered the event a success: while the Maker Carnival did not generate profit (on the contrary, its organizers contributed personal funds to make it happen), the event triggered significant international visibility. Mitch Altman, a key figure in the American hackerspace scene, gave one of the keynote lectures, and 28 foreign makers received stipends to attend the event. The Maker Carnival was the first of many maker-related events to follow, culminating in two featured Maker Faires in Shenzhen in 2014 and 2015, drawing significant investment from the Chinese government and from international corporations such as Intel, Qualcomm, Microsoft, and Arduino.

Over the years, through maker events and the efforts of a continuously growing number of hackerspaces [46,48,50], China's makers have carefully crafted a particular kind of image of making in China in relation to what many imagine to be a *global* maker movement. For instance, two of China's most prominent open source hardware companies, Seeed Studio and DFRobot, sell the majority of their products and services to individual makers, start-ups, educational entities and hackerspaces in North America and Europe. Similarly, prominent hardware incubator programs like HAXLR8R and Highway1, while leveraging the manufacturing ecosystem of the city of Shenzhen [47,49], are backed by European Venture Capitalists, and operate through a powerful network of start-ups, media relations, venture capitalists, and big corporates, many of which have ties into Silicon Valley. Alongside foreign venture capitalists, Western tech media have joined in to promote Shenzhen as the new "Silicon Valley for Hardware," e.g., [4,13,78]. In this imaginary of a global future, regions like Shenzhen are portrayed as being modernized by the intercessions of ideas or practices of (predominantly Western) venture capitalists, entrepreneurs, and designers, who move the region from "copycat culture to innovation" [78]. But this story of China's transformation from "backwards" copy to

"international" innovation culture is problematic, which Shenzhen's roots in alternative (not-Western centric) global assemblages make immediately visible. Let us briefly elaborate.

As a special economic zone, Shenzhen was a key region during the West's outsourcing boom [47] (see [56,57] for a detailed account of Shenzhen's urbanization). Since the 1980s, many electronics manufacturing companies had set up shop in Shenzhen, the most well-known being the Taiwanese companies Foxconn and HTC [33,52]. From the Apple iPhone to the Tablet sold at Wal-Mart, Shenzhen had become a key site in global end-consumer electronics production. However, over the last 20 years, the region has not only produced computers and mobile devices commissioned by corporations such as Apple, Nokia and HP, but has also begun develop its own lines of products, shipped to markets that had remained largely untapped by international tech firms: populations in Africa, India, Asia, South America unable to access and/or afford the international brands. This manufacturing practice is often described as *shanzhai* (山寨) in Chinese, referring to a network of some thousand factories in the South of China, whose open sharing practices have enabled them to become competitive in global markets [47]. The global assemblages of *shanzhai* production extend beyond the more familiar China-US-Europe triangle, and include other regions typically not associated with global tech innovation and original design.

In their theory of global assemblages, Ong and Collier suggest staying close to the practices that "rearticulate and reassemble material, technical and discursive elements in the process of remaking particular contexts" [58]. Following this approach, we account here for the ways in which aspirations of China's makers play out in both their material engagements with and their discursive construction of Shenzhen and *shanzhai*. China's makers position China's history and culture of manufacturing, especially as lived and practiced through *shanzhai*, key to the ideals of the maker movement; only if the global maker movement (and with it the West) took seriously Chinese manufacturing as equal partner in IT design and innovation, will the maker movement be able to accomplish its ideal to truly democratize technology production [46].

Making Assemblages in Taiwan

The maker scene in Taiwan reflects its present political situation. Taiwan evolved to a multiparty democratic government in the 1980s and 90s. Taiwan's young democracy is situated in a complex history. The island itself was originally peopled by aboriginals, but beginning in the 17th century saw immigrants from nearby China come to the island as well as a succession of foreign rulers: the Dutch, Spanish, Chinese, and Japanese all occupied Taiwan from the 17th century through the 1940s. In 1949, the government of the Republic of China (ROC), having lost the Chinese Civil War to the communists, relocated to Taiwan. Today, citizens of Taiwan are politically divided between those seek-

ing eventual reunion with China and those who wish to declare independence from China, though all view Taiwan/ROC as a sovereign nation. For its part, China considers Taiwan a renegade province and has made credible threats to invade it, if Taiwan does not submit to PRC rule.

In short, Taiwan has an ongoing project of self-identity—ROC vs. Taiwan, Chinese vs. Taiwanese, nation vs. province. But this project has urgency; people of Taiwan feel threatened that their way of life could disappear. This includes the threats of the destruction of their liberal democracy by a Chinese invasion, Taiwan's fading influence as it is politically and economically isolated from the rest of the world, internal divisions between a Chinese- vs. Taiwanese-identifying electorate, and the threat of distinctively Taiwanese ways of life, rituals, and craft traditions dying out in the age of global entertainment media. Taiwan's maker movement views the democratizing of making as a resource for pursuing the very existence of this society; that is, the democratization of computing in Taiwan is a proxy for a larger conversation about Taiwan itself.

Making is enmeshed in Taiwan's creative and cultural industry policy. This policy seeks to build on the economic significance of professionals operating in the overlapping creative (*e.g.*, design, computing, advertising, media, *etc.*) and cultural (*e.g.*, tourism, heritage, parks and recreation, museum, *etc.*) industries. In Taiwan, as in many other places pursuing such policies, the goals are not merely economic but they are also part of the project of forging a national identity. The policy seeks to construct a vision of Taiwanese culture that can drive the economy and also identify Taiwanese styles and products globally. It does so first by identifying distinctively Taiwanese creative industries (*e.g.*, traditional Taiwanese crafters) and also industries where Taiwan is particularly strong (*e.g.*, computer science and engineering); then this policy seeks to experimentally fuse these industries, in an attempt to cross-pollinate their respective strengths. For example, the government has hired design firms to engage with crafters in hopes of transitioning crafts to exportable products [9]. More recently, it is supporting the maker movement as it combines fabrication, design, art, entrepreneurship, and hacking. In March 2015, the former Air Force Command Headquarters in Taipei City was transformed into a world-class "TAF [Taiwan Air Force] Innovation Base," a co-working space for making-enabled entrepreneurship with substantial technical and economic support. However, the movement itself offers distinctly different visions for making's role in Taiwan's society, which we articulate through examples.

Taiwanese "puppet opera" (布袋戲) was originally a popular form of street theater. This 200-year-old tradition can be seen everywhere in Taiwan, in streets and festivals, government-sponsored cultural events, and in popular media. A typical performance includes elaborately decorated traditional stage, stylized performance techniques, and hand-crafted wooden puppets. Puppeteers undergo extensive ap-

prenticeships in both performance and fabrication. Chen Bo-Jian (陳伯健) is a master in this tradition, and he is also well known in the Taipei maker scene. He has collaborated with FabLab Taipei, OpenLab Taipei and other maker groups to use 3D printing, laser cutting, and other emerging technologies to transform and update the painstaking fabrication of puppet opera stages and puppets, combining traditional techniques and materials with new ones.

Chen also uses this work to make a strong political statement. In public presentations and interviews, Chen argues that "culture and creativity industry must exist to be in service of Taiwanese tradition, not the other way around." Chen is not arguing against an entrepreneurial vision of making in favor of a hobbyist vision in which makers should be free to do what they like. He is more specifically rejecting the notion, pursued by the government through its creative and cultural industries policy, that Taiwanese arts, crafts, styles, and rituals should be pursued for their market potential. He argues instead that Taiwanese ways of life themselves are the highest goods, and that economic development is a tool to support them. His political enemy is not an external threat, such as that of the Chinese military, but an internal threat: the subjection of Taiwanese ways of life to global capitalism by well-intentioned bureaucrats. Chen's political position is common among many (but not all) of the maker spaces in Taipei. They view the rise of making as an opportunity to perpetuate distinctively Taiwanese forms of life into the future, and for such a project to be successful, making has to become a widespread cultural practice. This view provides a substantive basis for specific educational reform proposals, in which educational institutions are tasked with disseminating the Taiwanese cultural practice of making, as it disseminates Taiwan's history, language and literature, and everyday skills such as arithmetic, writing, and civic participation.

Yet an alternative position is also prevalent in the Taipei maker scene. This view emphasizes making as key to innovation and entrepreneurship. For example, Taiwan's government has sponsored making-related innovation competitions, hackathons, and co-working spaces with the goal of cultivating the next generation of IT professionals. The government also supports major local, regional, and Asia-Pacific conferences such as COSCUP (Conference for Open Source Coders, Users and Promoters) and the FabLab Asia Network Conference 2015, which featured participation from over 80 labs located in 20 Asia-Pacific nations.

In this spirit, Taipei maker communities MakerPro and FutureWard focus on the economic potentials of making. Both MakerPro and FutureWard are supported in part by government funding, work closely with city and national government agencies, and are well positioned to execute the agenda of the creative and cultural industries policy. MakerPro focuses on maker-to-entrepreneur pathways, providing workshops, consulting, and networking opportunities. FutureWard operates on a membership dues model, but its

1,000m² facility is physically located on the campus of Ta-Tung University in central Taipei, and students use its facilities as part of their coursework. Interestingly, FutureWard also hosted a week-long hands-on workshop for a couple dozen employees of the Labor Department within the Taipei City Government in 2015, the purpose of which was to educate government employees about making.

The two ideologies of making outlined here—the culture and the economic framings—are often articulated by makers as though they are in opposition. For example, OpenLab Taipei aligns itself with artistic maker practices and argues against making as a form of entrepreneurship; informants at places like MakerPro and FutureWard stress the need to realize making’s economic potential. These conflicting visions of making are reflected in a hotly contested debate between two translations for “maker”: 自造者 vs. 創客. Both terms translate as “maker” but they have very different connotations. The first aligns itself with notions of the self-made, while the latter has strong connotations of entrepreneurship. Puppet master Chen uses the former, while the latter is common at MakerPro and FutureWard. Makers in different spaces use these different formulations both to articulate their individual identities and also affiliation with a normative stance about what making in Taiwan should be.

These two formulations of making are strongly and frequently asserted. But we noticed in our ethnographic work that clear ideological lines are blurrier in practice. For example, the same individuals who sharply criticize government policies—to the point of joining in major public demonstrations against them—nonetheless collaborate in spaces that are government subsidized; they collaborate with government officials; they participate as judges in government-sponsored competitions; they show up to and work in spaces with an entrepreneurial focus. It is also a credit to these government officials that they financially and professionally support makers who are publicly criticizing them. In short, there appears to be a sense of a shared enterprise, but exactly what it is, and how it should be prioritized and perpetuated, is being actively and openly debated in a democratic way.

In their theory of global assemblages, Ong and Collier [58] stress the inability to reduce assemblages to a single logic, and we see that at work in the Taipei maker scene. Taiwan’s take on creative and cultural industries helps explain this in part. All of the diverse maker sites are instances of the global “maker movement” in their (flexible) deployment of maker technologies, tools, ethos, recruitment methods, self-presentation tactics, sanctioned maker identities, and so on. Additionally, they all make credible arguments that they are operating broadly within objectives, principles, and values of the culture and creative industries policy, because they promote distinctively Taiwanese practices, styles, materials, and traditions (common practices at OpenLab and FabLab) and/or they contribute to Taiwan’s engineering and IT culture (common practices at MakerPro

and FutureWard). Many makers vocally disagree with the specific ways that the policy (in their view) subordinates cultural ends to economic ones, rather than the other way around. Others criticize the artistic crowd of failing to make a real impact (often understood in market terms). The government appears to be willing to let both sides hold this debate and support them in diverse ways.

MOVE 2: ANTICIPATORY DESIGN

We now turn to our second move, *anticipatory design*, in which fragmentary images—in our case, images of making from our empirical work—are used in a way analogous to how an archaeologist reconstructs past cultures from fragments of pots and houses left behind: to creatively and speculatively imagine the wholes that these fragments were part of. The difference is that whereas the archaeologist is attempting to construct a holistic understanding of an actual culture in the past, in this anticipatory design practice the holistic understanding is of a world not yet existing, but potentially worth pursuing. The anticipatory design practice is a method to study forms of life to discover and build on the glimmers of the utopian in them, however partial or imperfect they may be. These glimmers are then brought forward to form actionable aspirations and alternatives. Importantly, anticipatory design is not about assessing if a utopian project meets or fails to meet the standards of utopianism. Instead, feminist utopian sociologist Ruth Levitas writes of anticipatory design that it proposes “provisional hypotheses about how society might be” which are not intended as forecasts, but rather as invitations to “both writer and reader to imagine themselves, as well as the world, otherwise,” initially considered with “a suspension of disbelief” [45].

Applied to HCI’s relationship to making, anticipatory design can support intervention within making to bring about participation and democracy in technology use and design. In this paper, we apply anticipatory design to our analysis of making as global assemblages, precisely to uncover concrete and specific moments where technology appears to have been deployed, however provisionally or temporarily, in a utopian way. In collecting these moments, our goal is to contribute towards realizing the democratic potential of making, in which the empirical present is articulated as a vision of how it can be otherwise. We align our approach with work by Introna and Nissenbaum [38], pushing technology towards more democratic outcomes. In the following pages, we use this approach to draw out utopian glimmers from our ethnographic research in China and Taiwan.

Utopian Glimmers in China

What started out with a single hackerspace in Shanghai in 2010 morphed into a complex sociopolitical project of “mass making” that spans industries and regions today: China currently is estimated to have more than 1,000 maker spaces, and a new national policy entitled “mass makerspace” (众创空间) that enrolls making into a much larger social, economic, and educational program aimed at trans-

forming China from a manufacturing to a global knowledge economy. Within only 5 years, making in China has become part of a national policy and attracts foreign investment. Intel has invested millions of USD in the South of China to support China's "mass makerspace" initiative, and hundreds of makers-turned entrepreneurs from across the globe have traveled to China to realize their commercial Internet of Things product visions by partnering with local factories [47].

Much like elsewhere though, these activities started out much earlier, in part driven by the efforts of a few idealists [46,50], an eclectic collective of artists, social entrepreneurs, open source hardware geeks, and bloggers, active since 2007 and operating within tech companies, coworking spaces, makerspaces, and non-for profit organizations in China. Their underlying rationale was that by adopting the principles and values of the free culture movement, China's society as a whole could be opened up so to enable individuals to explore alternative life- and workstyles, different from what the government or their parents' generation had set out for them [46,50].

A sense of euphoria was central to these early projects; many believed that the values associated with the free culture movement such as open source, peer production, and collaboration would lead to both individual and collective freedom, civic engagement, and economic transformation. It was a utopian project that coincided with the rise of Chinese social media such as Sina Weibo, celebrated as enablers of digital democracy and the birth of a new liberated citizen – the netizen (网民) [51, 80]. China was on the upswing; with a rapidly swelling economy, it seemed almost immune to the 2008 economic crash. It was an enticing moment documented by China's tech enthusiasts, international journalists and scholars alike [53].

Fast forward to 2015; the Chinese economy is witnessing a major slow-down with ripple effects in the global economy and stock market. Earlier visions of open sharing are now packaged under the banner of "mass innovation" or "mass making," promoted by the government as the crux to get the economy back on track by turning citizens into entrepreneurs, innovators, and makers. On first glance, the counterculture from 2007 appears co-opted by capitalism with Chinese characteristics. Since President Xi Jinping took over office in 2012, arrests and central control over media outlets and digital media have reportedly increased [59, 78], while start-up culture and venture capital investment are encouraged in ways comparable to the West [11, 30, 55].

And yet, to portray China's maker scene as a story of co-opted counterculture would render invisible earlier and continuous efforts by China's makers to situate their work, neither outright against nor for the system [50]. A story of co-option would run the risk to critique these efforts, utopian they might be, as elitist or technologically deterministic. Our goal here, then, is to intervene and amplify the glimps-

es and moments of alternatives we observed in China's maker culture, rather than shut them down. Here we deploy the utopian anticipatory design move to seek the materials of a preferable future in fragmentary form in the present.

Open Source & Partnership

In 2007, Ricky Ye (叶琛) returned to Shanghai from graduate school in England, where he had begun working on an open source robotics project with a group of fellow enthusiasts distributed across Europe and China. Upon his return to China, Ye continued the work and began showcasing some of the early DIY robotics hacks in the Shanghai coworking space XinDanWei (新单位), which was at that time an important meeting spot for advocates of the free culture movement in China. Today, Ricky Ye is the CEO of one of China's most well-known open source hardware businesses: DFRobot. In some ways, DFRobot might be reminiscent of a typical Silicon Valley start-up success story. And yet, the ways DFRobot began and continues its operations offer an open source business model that differs from the more widespread Silicon Valley approach of creationist capitalism [11]; DFRobot's business model is structured around enabling hobbyist roboticists, newcomers to making as well as aspiring hardware start-ups to either expand their prototyping skills and/or move into professional product development. The business is rooted in a model of partnership: DFRobot offers expertise in design for manufacturing, prototyping, and engineering, while hobbyist makers offer a continuous stream of ideas. Start-ups and hobbyists can build on the company's open source hardware platforms, working with its designers and engineers to improve and expand both hardware and ideas. If one side decides to move into production, the revenue is shared.

This model of partnership, which might be better characterized as peer-entrepreneurship than peer production, is fundamentally different from the much more widespread tendency to exploit participants in technology production as contributors of free labor [11, 73]. This includes business models of prominent social media sites like Facebook, mining online behavior to sell it back its users in the form of advertisement, but also newer companies like MakerBot, which has productively leveraged its online community of enthusiastic contributors in order to gain reputation, free contributions and eventually economic value. In a 2014 keynote at the first featured Maker Faire in Shenzhen, Chris Anderson, former editor of *Wired* Magazine and now CEO of 3DRobotics articulated this business model as follows: "This is really the main asset of the maker movement... it creates a community of enthusiastic people who share for free. Our company has hundreds of developers around the world, who we don't have to pay or to hire, because we have created a place where they can feel part of something... how do we reward them? We teach them. How do we pay them? With a coffee mug! If they commit code, we give them a t-shirt. They love that, because it's an official recognition of their contribution." Open source, here, is rendered as a business model that rests on low-paid or even

free labor. It recalls what Gina Neff [55] has termed “venture labor” where people began to “think of their jobs as an investment or as having a future pay-off other than regular wages.” Similarly, here, Anderson bets on the fact that “hundreds of developers around the world” are offering their know-how and expertise in exchange for “feeling part of something.”

DFRobot offers an alternative. It is not a big step or a revolutionary program. It is a pragmatic business model, aimed at making revenue and not at overthrowing existing structures of state control or the global processes of capitalism. It also remains a fairly exclusive project; reserved to those who can afford to traverse in international start-up land or engage in hobbyist production. It is not a revolutionary tool for the masses of workers on the factory floor. And yet, its underlying business tactic is exactly what makes it an alternative worth exploring; in contrast to companies like MakerBot, DFRobot demonstrates that open source hardware can be part of a successful business model. It is a hint of utopia practiced within (not against) a capitalist mode. DFRobot’s business model firmly incorporates the ideals of many open source hardware enthusiasts – peer production and open sharing of knowledge, code and other resources – extending them into business: the sharing of profit and revenue or peer-entrepreneurship. We do not mean to imply, here, that DFRobot stands for some kind of authentic Chinese utopianism that would be intrinsically better than projects in the US or elsewhere. Rather, DFRobot’s story allows us to show how a utopian alternative materialized as an economic model in a place typically associated with tight state control and authoritarianism. The DFRobot case, in other words, makes visible what Suchman has called “the multiplicity of places in which different but also potentially related future-making practices occur” [Suchman in: 25].

With this account from China, we aim to offer two particular take-aways: First, the opportunity of peer-entrepreneurship. We have outlined earlier in this paper that China’s makers (like those working at DFRobot) reframe Chinese manufacturing in the global imaginary as a partner in both design and production. The tagline of China’s first featured Maker Faire in 2014, for instance, was “Innovate with China,” used to demonstrate that Chinese manufacturing can mean something else than copycat or low quality production. The business model of DFRobot is organized around this ambition to position manufacturing as partner in innovation. A possible stance that follows for HCI is to envision ways to engage in such partnerships during research and design. HCI has a long tradition of partnering with industry; however, this involves mostly large international corporations such as Microsoft, IBM, Intel, Nokia, and so on. What would a partnership look like with a small open source hardware business like DFRobot? Possible outcomes could include the developing of open hardware platforms for education and design research, and the ideation of alternative economic models that might also be taken up by larger corporations and educational institutions.

Thinking about research impact in terms of business and market has been explored peripherally in HCI, but becomes pressing as HCI visions and approaches from participatory design to ubiquitous computing are commodified [5].

Second, DFRobot shows that innovative forms of entrepreneurship within a capitalist framework do not have to be antithetical to critical intervention. This observation extends a body of work in HCI that has challenged the sharp distinction between critical design and affirmative design [6]. Looking for moments of critical intervention in entrepreneurship can be productive for HCI to expand its critical scholarship beyond the confined circles of people who can afford attend conferences like ACM CHI.

Utopian Glimmers in the Taipei Maker Scene

In its many makerspaces, with free or inexpensive access to cutting edge tools and skilled communities to support their use, Taiwan replicates one of the major democratizing tactics of the global maker movement. What makes it specifically Taiwanese? Taiwan in general, and in its maker scene, is engaged in a kind of dialectic. On the one hand is the threat to its existence as an autonomous nation-state—hardly a utopian source—which has the silver lining of creating solidarity among Taiwan’s people in spite of their other divisions: a solidarity that is committed to its democratic way of life, to presenting a coherent picture of itself to the rest of the world, and to perpetuating all of the above in future generations. On the other hand is its internal heterogeneity and divisions, the bitter debates concerning its relationship with China, whether people are “Taiwanese” or “Chinese from Taiwan,” whether the history of China or the island of Taiwan should be taught in schools, and so forth.

The meaning of making is among other things a proxy conversation for this dialectic. Makers are thrown together as a community by the global maker movement, including its organizational, technical, and ideological apparatuses. Taipei’s makers are eager to convince others of the potentials of making, but they are also divided about what those potentials are. Is making a life skill through which one enacts and perpetuates cultural citizenship? Is it a professional skill through which one contributes to the national economy? Can making contribute to the commodification of Taiwan as a style or brand in the global marketplace or encourage tourism? Common to all of these questions is a focus on collective, rather than individual, interest. We saw no evidence of making pitched as a way for an individual to “get ahead” or to expressing oneself creatively. The collective tended not to be framed in terms of fellow makers, either, but of all Taiwan, present and future. Again, we believe that collective interest may have something to do with the sense of threat shared by Taiwan’s citizens, and perhaps more broadly by collectivist tendencies in Asian culture. Regardless, *making is pursued in Taiwan as a technology of the national self*, as a collection of national self-making techniques organized by a social vision.

But it is also important to stress the democratic nature of this process. There is no authority in charge of making in Taiwan, no one institution that has the power to decide how it unfolds. The makers see themselves as ambassadors of the global maker movement, but as we have seen they offer different interpretations of its significances and potentials for Taiwan. Both national and city governments also have an interest in making, because of its potentials for creative and cultural industries, which they are eager to promote. Policymakers have framed this policy in more market-driven terms than many of makers like. Yet the government has supported strands of making that would seem to yield little hope of impact on strictly market terms. Taipei seems to be testing, through trial and variation, many forms and ideologies of making to see which ones stick.

One of our informants, an entrepreneur born in Hong Kong who earned graduate design degrees at an Ivy League university before returning to Asia, told us that he decided to open up his making consultancy and design business in Taipei, rather than Hong Kong, Shanghai, or Shenzhen for two reasons: he felt that Taiwanese engineers were inexpensive relative to their ability, and that Taiwan was the only free Chinese society in the world. This combination was promising, he said, because it meant that high quality startups would be less expensive in Taipei than elsewhere, and because the freedoms of a democratic society meant that their creativity would be unfettered. For this entrepreneur, Taiwan's freedom is not merely a political ideal; it serves in an epistemic capacity, as a condition of possibility for heightened creative practice.

Taiwan's maker scene is functioning today as a workshop for discovering ways that a democratized technology can contribute to a social vision of a lasting, self-sufficient, and sovereign society, yet divided, even extremely divided, on what that vision should entail and how to bring it into being. A key mechanism of this project—in whichever of its many forms it is construed—is that the democratization of technology via making is seen as a national need. We never heard in Taiwan, as we have in the U.S., the relatively passive approach to recruiting participation in making, “our doors are open and everyone is welcome.” Instead, there are diverse tactics of taking making to the public: by placing it in a university and requiring students to use it; putting maker tools and kits on 500 trucks and driving them out to rural communities in Taiwan [75]; inviting the public to free workshops on entrepreneurship; updating and reinvigorating everyday Taiwanese cultural practices, such as puppet opera, via making; bringing in policy makers to makerspaces and teaching them to make; and by the government publicly embracing and supporting conflicting forms and ideologies of making, even when those very makers take to the streets to attack those same policies.

The utopian glimmer is our amplification of the point that the Hong Kong-based entrepreneur raised: the idea that democracy can serve in an epistemic capacity to intensify

creative potential at scale. Specifically, we see the union of the cultural value of *collectivism* merging productively with the democratic value of policy supportive of and also informed by *robust debate*. The debate allows for the proliferation of alternative visions and models of making and maker practices, as we saw in the debate between making as cultural work vs. making as entrepreneurial work. The collectivism orients making towards a common good, rather than an individual good; in other words, the development of distinctively Taiwanese practices of making is oriented towards a national future—be it economic, pedagogical, or cultural. Meanwhile, government agencies do not sit on the sidelines but actively participate, both materially and symbolically supporting divergent maker groups and ideologies, even as they make their own priorities known (e.g., to stimulate economic growth and to promote Taiwan's creative and cultural life). We thus understand democracy serving in an epistemic capacity to support collective creativity at scale in the context of Taiwanese making as follows: it entails a model that robustly allows for heterogeneous experiments in peer-based innovation, which both influences and is influenced by government agencies, and which contributes towards an evolving conception of the public good.

DISCUSSION

This paper began with the articulation of one of making's central commitments – the democratization of technology production. Making gives new appeal to HCI's own long-held values and commitments to user participation; making challenges whether there is (or needs to be) a gap between designers and engineers on the one hand, and between designers and end users on the other. Making also raises questions about computing itself. It challenges the long-standard view that end users manipulate software but not hardware. Making and HCI, in other words, are not separate phenomena but instead mutually implicated. And yet, while HCI has pursued making as an avenue to increase participation, HCI research has also critiqued that there is an underlying technosolutionism to making, *i.e.* technology is seen as solution for social, economic and political problems. One feature of the technosolutionist vision is that it tends to treat making as an undifferentiated global form. Such a reduction abstracts out the local work in diverse sites. Following anthropologists of the global, we have argued that it is in the specific instances of global forms where possibilities of making are developed and realized.

Throughout the paper, we have articulated preferable futures, rooted in a critique of the present, to offer a way out of the dilemma of HCI as it both contributes to and critiques making's utopian vision. We now return to the question we posed up front: Could we blend the contributions of technologists who are opening up making to new uses and users with the contributions of critical voices to pursue the democratization of making as an equally sociotechnical research practice? What we have hopefully demonstrated throughout this paper is that the answer to this question is

yes, but it demands a reflexive-interventionist move, which we characterize as “democratizing from within.”

HCI: Democratizing from within

As scientists, we HCI researchers often view ourselves as outside observers of computational domains of interest. Such a view is disadvantageous not only because it does not acknowledge our own participation in such domains—via the development of tools, the framing of research issues, and the marshaling of resources—but it is also self-disempowering. HCI researchers share in many ways making’s utopian vision to democratize technology. This, we believe, creates an opportunity and obligation to pursue the democratization of maker assemblages and do so through approaches we outlined in this paper – a critique of the present and anticipatory design. In many obvious ways, we already do this. When HCI technologists develop a new tool to support making, we introduce at least the potentiality for the democratic uptake of that tool. When HCI social scientists help us understand a collaborative behavior, such that we can better support it, we introduce at least the potentiality for democratic empowerment. But there are more subtle ways that we do (or at least could). In naming and framing making as an object of inquiry, we ourselves end up resourcing, judging, championing, inhibiting (and so forth) making. When we understand the projects and materials that appear in *MAKE Magazine* or at Maker Faires as exemplars of making, this is not an innocent description. When we justify making research because it stimulates economies or functions as a crowdsourced laboratory of the Internet of Things, this is not an innocent description. In each case we are contributing to the discursive formulation—and to the assemblaging—of making. This is a form of agency, of power/knowledge [27], that we have.

If we view ourselves as implicated in global assemblages of making, what power does that grant us as actors to contribute towards the democratization of computing? We argue that it might inhere in our field’s ability to engage technologies and situated actions at the same time, *i.e.*, to perceive how technologies do and do not democratize. Put another way, a given technology or social formation can be directed towards more versus less democratic outcomes. We need a stance, then, that acknowledges and augments our agency to push towards more rather than less democratic outcomes.

Making inevitably poses opportunities and challenges for the democratization of computing. If technologies are expensive, difficult to use, or if their functionalities or aesthetics speak to some ways of life more than others, they can inhibit widespread use. It was Leah Buechley’s insight that Arduino seemed to resonate with men more than women, and she sought to redesign it in a way that would resonate more with women [14]. But this is not just a technological issue. If individuals cannot see themselves in an existing collective, they will not join it. If laws make certain forms of making difficult or impossible, they also affect who makes, and what they make [61]. Clearly the mantra “eve-

ryone can be a maker” is optimistic—certain kinds of makers and making are encouraged or discouraged based on the spaces, ecologies, networks, and discourses in which making is construed as a reflexive practice.

In this last point there is a role for HCI researchers: to leverage our empirical accounts of maker practices in a utopian analysis to identify those specific and situated democratizing forms and bring them back into the global conversation. In this paper, we showed how making in China can thrive using labor partnerships instead of exploitative labor relations, and can, despite its business-focus, also pursue and achieve critical outcomes. As we showed in Taiwan, making can be democratically debated and diversely pursued without becoming so individualistic that it loses its political capacity to democratize technology as part of a more ambitious social project. Taken together, these two maker scenes demonstrate that the democratizing potential of making can occur not only by empowering individuals (*i.e.*, as often articulated in the West), but also by empowering collectives—maker groups, entire cities, even nations—to pursue their collective goals in and through making.

What is needed, then, in research on making is a reflexive-interventionist stance, if HCI is to pursue the democratization of technology in a sociotechnical way. In its reflexivity, it seeks to account for, and be accountable to, our positions as actors in the computing arenas we research and design for. In its interventionism, it seeks to give substance and new resources to the pursuit of democratization beyond technosolutionism. In our practice, we have sought to de-center our own HCI theoretical predispositions as Western academics by engaging in making praxis in Shenzhen and Taipei. We have sought to acknowledge and celebrate the technological achievements that have created so much potential to empower people to design hardware. But we have sought also to understand the sociopolitical, legal, national, urban, and ideological contexts in which these technologies are deployed, to reveal in them glimmers of democratization that are not part of the global currency. Out of those glimmers, we seek to fashion new practices, models, technologies that could be used to augment and amplify their democratizing potentials.

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REFERENCES

1. Morgan G. Ames, Daniela K. Rosner and Ingrid Erickson. 2015. Worship, Faith, and Evangelism: Religion as an Ideological Lens for Engineering Worlds. In Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing, CSCW'15, pp. 69-81.
2. Morgan Ames, Jeffrey Bardzell, Shaowen Bardzell, Silvia Lindtner, David Mellis, and Daniela Rosner. 2014. Making Cultures: Empowerment, Participation, and Democracy - or Not? In Proc. Panel at CHI'14, ACM Press (2014), pp. 1087-1092.
3. Chris Anderson. 2012. Makers. The New Industrial Revolution. Crown Publishing Group, New York.
4. Zachary Bako. 2015. How a Nation of Tech Copycats transformed into a Hub for Innovation. Wired Magazine. <http://www.wired.com/2015/12/tech-innovation-in-china/>, last accessed Jan 3, 2016.
5. Liam Bannon and Pelle Ehn. 2012. Design Matters in Participatory Design. In: J. Simonsen and T. Robertson (eds) Routledge Handbook of Participatory Design, pp. 37-63.
6. Jeffrey Bardzell and Shaowen Bardzell. 2013. What is "critical" about critical design? In Proc. of CHI'2013. ACM: New York.
7. Jeffrey Bardzell, Shaowen Bardzell, and Austin Toombs. 2014. "Now that's definitely a proper hack": Self-made tools in hackerspaces. In Proc. of CHI'2014. ACM: New York
8. Shaowen Bardzell. 2015. Utopian Design. In Reconceptualizing Critical Utopia panel at Aarhus 2015, the Decennial Conference on Critical Alternatives. Aarhus, Denmark.
9. Shaowen Bardzell. 2014. Utopias of Participation: Design, Criticality, and Emancipation. Keynote address at the 2014 Participatory Design Conference. In Windhoek, Namibia.
10. Shaowen Bardzell, Daniela Rosner, and Jeffrey Bardzell. 2012. Crafting quality in design: Integrity, creativity, and public sensibility. In Proc. of the Designing Interactive Systems Conference, DIS 2012. ACM: New York, pp. 11-20.
11. Tom Boellstorff. 2008. The coming of age in Second Life: an anthropologist explores the virtually human. Princeton University Press.
12. Seyla Benhabib. 1992. Situating the Self: Gender, Community, and Postmodernism in Contemporary Ethics. Routledge: New York.
13. Gareth Branwyn. 2015. An Insider's Guide to Shenzhen Manufacturing. Makezine. <http://makezine.com/2015/06/15/making-in-shenzhen/> last accessed September 2015.
14. Leah Buechley and Benjamin Mako Hill. 2010. LilyPad in the wild: How hardware's long tail is supporting new engineering and design communities. In Proceedings of the Designing Interactive Systems Conference, DIS 2010. ACM: New York, pp. 199-207.
15. Leah Buechley, Qiu, K., and de Boer, Sonja. Sew electric: a collection of DIY projects that combine fabric, electronics, and programming. HLT Press, Cambridge, MA, USA 2013.
16. Leah Buechley and H. Perner-Wilson. 2013. Crafting Technology: Reimagining the Processes, Materials, and Cultures of Electronics. Journal ACM Transactions on Computer-Human Interaction (ToCHI), Vol 19, Issue 3, Article No. 21.
17. Anita Chan. 2014. Networking Peripheries. Technological Futures and the Myth of Digital Universalism. Cambridge, MA: MIT Press.
18. Ruy Cervantes and Bonnie Nardi. 2010. Innovating from the Global South: practices to connect local and global networks of innovation. In Proc. of ICIC'10, pp.259-262.
19. Susan Currie Sivek. 2011. "We Need a Showing of All Hands" Technological Utopianism in MAKE Magazine. Journal of Communication Inquiry 35, 3, pp. 187-209.
20. David Cuartelles. 2014. How Deep is your Love? On Open-Source Hardware. In: Making Futures. Marginal Notes on Innovation, Design and Democracy (eds Pelle Ehn, Elisabet M. Nilsson, Richard Topgaard), Cambridge, Massachusetts: MIT Press.
21. Laura Devendorf and Kimiko Ryokai. 2014. Being the machine: exploring new modes of making. In Proc. of the Designing Interactive Systems Conference, DIS'14, pp. 33-36.
22. Laura Devendorf and Daniela K. Rosner. 2015. Reimagining Digital Fabrication as Performance Art. In: Extended Abstracts of the ACM conference on Human Factors in Computing Systems (CHI'15), pp. 555-566.
23. Paul Dourish. 2006. Implications for Design. In Proceedings of the ACM SIGCHI Conference on Human Factors in Computing Systems (CHI'06), pp. 541-550.
24. Paul Dourish and Scott D. Mainwaring. 2012. Ubicomp's Colonial Impulse. In Proceedings. of UbiComp'12, Springer, pp. 133-142.
25. Pelle Ehn, Elisabet M. Nilsson, Richard Topgaard (eds). 2014. Making Futures. Marginal Notes on Innovation, Design and Democracy. Cambridge, Massachusetts: MIT Press.
26. Daniel Fiton, Janet C. Read, John Dempsey. 2015. Exploring children's designs for maker technologies. In Proc. of IDC'15, pp. 379-382.

27. Michel Foucault. (1977). *Discipline and Punish: The Birth of the Prison*. Alan Sheridan, trans. New York: Vintage Books.
28. Sarah Fox, Rachel Rose Ulgado, Daniela Rosner. 2015. Hacking Culture, not Devices: Access and Recognition in Feminist Hackerspaces. In Proc. of CSCW'15, pp. 56-68.
29. Neil Gershenfeld. 2005. *Fab. The coming revolution on your desktop – from personal computers to personal fabrication*. Basic Books.
30. Mel Gregg. 2011. *Work's Intimacy*. Cambridge: Polity.
31. Donna Haraway. 2008. *When Species Meet*. Minneapolis, MN: University of Minnesota Press.
32. Hartman, B., Doorley, S., Klemmer, S. Hacking, Mash-ing, Gluing: Understanding Opportunistic Design. *IEEE Journal of Pervasive Computing*, 2008, Vol. 7, No. 3, pp. 46-54.
33. Josephine Ho. 2010. *Shanzhai: Economic/Cultural Production through the Cracks of Globalization*. Crossroads: Cultural Studies Conference.
34. Jonathan Hook, Sanne Verbaan, Abigail Durrant, Patrick Olivier, Peter Wright. 2014. A study of the challenges related to DIY assistive technology in the context of children with disabilities. In Proc. of DIS'14, pp. 597-606.
35. Scott Hudson. 2014. Printing teddy bears: a technique for 3D printing of soft interactive objects. In Proceedings of the ACM SIGCHI Conference on Human Factors in Computing Systems CHI'14, pp.459-458.
36. Lilly Irani, Janet Vertesi, Paul Dourish, Kavita Philip, and Rebecca Grinter. 2010. Postcolonial Computing: A Lens on Design and Development. In Proceedings of the ACM Conf. Human Factors in Computing Systems CHI 2010 (Atlanta, GA), pp.1311-1320.
37. Lilly Irani. 2015. Hackathons and the Making of Entrepreneurial Citizenship. *Science, Technology & Human Values* (Sage), Vol. 40, No. 5, pp.799-824.
38. Lucas Inrona and Helen Nissenbaum. 1999. *Sustaining the Public Good Vision of the Internet: The Politics of Search Engines*. Center for the Arts and Cultural Policy Studies, Working Paper #9, 1999, Princeton University.
39. Steve J. Jackson, Alex Pompe, and Gabriel Krieschok. 2012. Repair worlds: maintenance, repair, and ICT for development in rural Namibia. In Proc. of the ACM 2012 conference on Computer Supported Cooperative Work, pp.107-116.
40. Denisa Kera. 2010. "Bionetworking over DNA and Online Forms of Biological Citizenship: STS and Design Perspectives." *Genomics, Society and Policy* 6 (1): 47-60.
41. Denisa Kera and Connor Graham. 2010. Collective Sensor Networks and Future Communities: Designing interaction across multiple scales. In Proc. of OZCHI'10, pp. 396-399.
42. Beth Kolko, Alexis Hope, Brook Sattler, Kate MacCorkle, Behzod Sirjani Hackademia: Building Functional Rather than Accredited Engineers. In Proc. of the Participatory Design Conference (ACM), PDC'12, pp.129-138.
43. Stacey Kuznetsov, Nathan Wilson, Scott Hudson, Carrie Doonan, Swarna Mohan, and Eric Paulos. 2015. DIYBio Things: Open Source Biology Tools as Platforms for Hybrid Knowledge Production and Scientific Participation. In Proc. of ACM SIGCHI Conference on Human Factors in Computing Systems, pp. 4065-4068.
44. Stacey Kuznetsov, Alex Taylor, Nick Villar, Time Regan, and Eric Paulos. 2012. At the Seams: DIYBio and Opportunities for HCI. In Proc. of Designing Interactive Systems (ACM), DIS'12, pp. 258-267.
45. Ruth Levitas. 2013. *Utopia as Method: The Imaginary Reconstitution of Society*. Palgrave Macmillan.
46. Silvia Lindtner. 2015. Hacking with Chinese Characteristics: The Promises of the Maker Movement against China's Manufacturing Culture. *Science, Technology & Human Values* (Sage), Vol. 40, No. 5, pp.854-879.
47. Silvia Lindtner, Anna Greenspan, David Li. 2015. Designed in Shenzhen: Shanzhai Manufacturing and Maker Entrepreneurs. In Proc. of 5th Decennial Aarhus Conference on Critical Alternatives, Denmark, Aug 17-21, 2015, pp. 85-96.
48. Silvia Lindtner, Garnet Hertz, Paul Dourish. 2014. Emerging Sites of HCI Innovation: Hackerspaces, Hardware Start-ups, Incubators. In Proc. of the ACM SIGCHI Conference on Human Factors in Computing Systems (Toronto, Canada), pp.439-448.
49. Silvia Lindtner and David Li. 2012. Created in China: The Makings of China's Hackerspace Community. *ACM Interactions*, XIX. 6 November + December.
50. Silvia Lindtner. 2014. Hackerspaces and Internet of Things in China: How Makers are reinventing Industrial Production, Innovation & the Self. *Journal of China Information*, Special Issue on "Political Contestation in Chinese Digital Spaces" (ed. Guobin Yang), Vol. 28, No. 2, pp. 145-167.
51. Fengshu Liu. 2011. *Urban Youth in China: Modernity, the Internet and the Self*. New York: Routledge.
52. Boy L uthje, Stefanie H urtgen, Peter Pawlicki, and Martina Stroll. 2013. *From Silicon Valley to Shenzhen. Global Production and work in the IT industry*. Rowman & Littlefield Publishers.
53. Rebecca MacKinnon. 2012. *Consent of the Networked: The Worldwide Struggle for Internet Freedom*. New York: Basic Books.

54. David Mellis and Leah Buechley. 2014. Do-It-Yourself Cellphones: An Investigation into the Possibilities and Limits of High-Tech DIY. In Proceedings of the ACM SIGCHI conference on Human factors in computing systems, pp. 1723-1732.
55. Gina Neff. 2012. *Venture Labor. Work and the Burden of Risk in Innovation Industries*. Cambridge, Massachusetts: MIT Press.
56. Mary Ann O'Donnell. 2001. Becoming Hong Kong, Razing Baoan, Preserving Xin'an: An Ethnographic Account of Urbanization in the Special Economic Zone. *Cultural Studies* 15(3/4), 419-443.
57. Mary Ann O'Donnell. 2006. Attracting the World's Attention: The Cultural Supplement in Shenzhen Municipality. *Positions* 14:1.
58. Aihwa Ong and Stephen J. Collier (eds.). 2004. *Global Assemblages: Technology, Politics, and Ethics as Anthropological Problems*. Wiley-Blackwell.
59. William Overhault. 2015. The politics of China's anti-corruption campaign. *EastAsiaForum*. <http://www.eastasiaforum.org/2015/09/15/the-politics-of-chinas-anti-corruption-campaign/> last accessed September 20, 2015.
60. Matt Ratto and Megan Boler (eds). 2014. *DIY Citizenship. Critical Making and Social Media*. Cambridge, Massachusetts: MIT Press.
61. David Roedl, Shaowen Bardzell, Jeffrey Bardzell. 2015. Sustainable Making? Balancing Optimism and Criticism in HCI Discourse, *ACM TOCHI Journal*, VOL. 22, Issue 3, Article No. 15.
62. Daniela K. Rosner and Morgan G. Ames. 2014. Designing for Repair? Infrastructures and Materialities of Breakdown. In Proc. of CSCW, pp. 319-331.
63. Ananya Roy and Aiwah Ong. 2011. *Worlding Cities. Asian Experiments and the Art of Being Global*. Blackwell Publishing.
64. Gabriela T. Richard, Yasmin B. Kafai, Barrie Adleberg, Orkan Telhan. 2015. StitchFest: Diversifying a College Hackathon to broaden participation and perceptions in computing. In Proc. of SIGCE'15, pp.114-119.
65. Lucy Suchman. 2008. Striking Likeness to Difference. Paper presented at 4S/EASST (annual meeting of Society for Social Studies of Science), Rotterdam.
66. Sunflower student movement: <http://tinyurl.com/p58tjor>
67. Tom Phillips. 2015. Families of China's 'disappeared' say country is a place of fear and panic. *The Guardian*. <http://www.theguardian.com/world/2015/aug/31/families-of-chinas-disappeared-say-country-is-a-place-of-fear-and-panic>, last accessed September 20, 2015.
68. Jie Qi and Leah Buechley. 2014. Sketching in Circuits: Designing and building electronics on paper. In Proceedings of the SIGCHI conference on Human factors in computing systems (CHI'14), pp 1713-1722.
69. Yuling Sun, Silvia Lindtner, Xianghua Ding, Tun Lu, Ning Gu. 2015. Reliving the Past & Making a Harmless Society Today: A Study of Elderly Electronic Hackers in China. In Proc. of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing, pp. 44-55.
70. Yuri Takhtezev. 2012. *Coding Places. Software Practice in a South American City*. Cambridge, MA: MIT Press.
71. Joshua G. Tanenbaum, Amanda M. Williams, Audrey Desjardins, Karen Tanenbaum. 2013. Democratizing technology: pleasure, utility and expressiveness in DIY and maker practice. In Proc. of ACM CHI'13, pp. 2603-2612.
72. Alex Taylor. 2011. Out there. In Proceedings of the ACM SIGCHI Conference on Human Factors in Computing Systems (CHI'11), pp. 685-694.
73. Tiziana Terranova. 2000. Free Labor: Producing Culture for the Digital Economy. *Social Text* 63, Vol. 18, No. 2, Duke University Press.
74. Austin L. Toombs, Shaowen Bardzell, Jeffrey Bardzell. 2015. The Proper Care and Feeding of Hackerspaces: Care Ethics and Cultures of Making. In Proc. of ACM CHI'15, pp. 629-638.
75. vMaker action plan: <http://tinyurl.com/o6s38vt>
76. Ron Wakkary, Markus Lorenz Schilling, Matthew A. Dalton, Sabrina Hauser, Audrey Desjardins, Xiao Zhang, Henry W.J. Lin. 2015. Tutorial Authorship and Hybrid Designers: The Joy (and Frustration) of DIY Tutorials. In Proc. of ACM CHI'15.
77. Tricia Wang and Josef 'Jofish' Kaye. 2011. Inventive Leisure Practice: understanding hacking communities as sites of sharing and innovation. In Proc. of ACM CHI Extended Abstracts, pp. 263-272.
78. Tom Whitwell. 2014. Inside Shenzhen: China's Silicon Valley. *The Guardian*. <http://www.theguardian.com/cities/2014/jun/13/inside-shenzen-china-silicon-valley-tech-nirvana-pearl-river> last accessed September 20, 2015.
79. Amanda Williams, Silvia Lindtner, Ken Anderson, and Paul Dourish. 2014. Multisited Design: An Analytical Lens for Transnational HCI. *Journal of Human-Computer Interaction*, Vol. 29, Issue 1, pp. 78-108.
80. Guobin Yang. 2011. *The Power of the Internet in China: Citizen Activism Online*. New York: Columbia University Press.