Reading Makers

Locating Criticality in DIY and "Maker" Approaches

Minka Stoyanova

Abstract

Since its inception, digital and interactive art has been forced to negotiate the tension between the inherently spectacular nature of the technologies it uses and the desire of creators to embed relevant critical stances within the work. With the recent rise of "maker" or DIY culture, this negotiation has become even more pronounced as the production of technologies becomes more accessible and (allegedly) more democratized. In addition, our relationship with technology is becoming increasingly intimate. Whereas machines once could have been read as tools, through which we would enact our individualized wills, they now implicate themselves into our mental processes, our bodies and (one could argue) our very being. Within this cyborgian construction we risk mindless acceptance and integration of the particular logical models technology and its producers bring to the merger. A tension arises between our need to understand or recognize the logic which drives our lives and the technology, which often seeks to obfuscate that logic. This paper, through the application of philosophy of technology to a specific maker subculture – as it has been adopted by a movement in fine art (art and technology) – situates making as a form of artistic practice at the intersection of these ideas. As a mode by which technologically inclined artists can navigate the spectacular and the critical in their work, making allows these artists to enact criticality through revealing underlying technical (and social) logic in the systems (and objects) with which they engage. Thus, this paper will trace the philosophical foundations of this critical approach and finally analyse a series of works that reveal strategies through which "making" as a mode of "revealing" has been refined by artists as a critical approach to embedded technological systems.

Introduction

In the last decade, "maker culture" has experienced a renaissance. Popularized through rhetoric-filled TED talks and tech-education initiatives, this new "movement" has spawned a do-it-yourself (DIY) industry supported by emancipatory language. Examples include *Maker Media*, a media company which produces

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Make magazine; *Maker Faire*; and Maker Shed (*Maker Media's* online and pop-up storefront) as well as *TechShop*, a makerspace franchise launched in San Francisco. In connection to its rapid growth, the increasing popularity of its rhetoric and its expansion of the term "maker," a number of harsh criticisms have surfaced in response to the "maker movement." While some criticisms focus on cultural problems within the community such as citing inherent masculine coding and imbalanced gender dynamics in the maker industry (Chachra 2015), others question the movement's radicalism and DIY agenda – in light of its close ties to the military-industrial complex (in particular, the U. S. government and DARPA) (Driscoll 2012), as well as its often corporate branding and/or sponsorship. While these are legitimate concerns, perhaps the most salient criticism of the movement draws upon these criticisms to leverage a more general critique of the rhetoric and packaging of the movement.

It is this sort of critique that Evgeny Morozov levies in his 2014 article for *The New Yorker*, "Making It." Morozov begins the piece by drawing a parallel between the emancipatory language leveraged by the Arts and Crafts movement of the early 20th century and the contemporary rhetoric surrounding the maker movement. In both movements, he criticizes language which promises to emancipate workers through the popularization of DIY approaches: in the case of the Arts and Crafts movement, by freeing workers from the alienation of the factory, and in the case of the current maker movement, through the promise of freedom via entrepreneurship. Both movements claim that the ability to create one's own goods undermines capitalism's system of mass production and consumption. As Morozov correctly identifies, both movements, instead of undermining consumer behaviour, spawned a new consumer group, supplied by new cabals of opaque corporate interests with questionable funding and growth models. Thus, for Morozov, the rise of the maker industry exemplifies capitalism's ability to subsume and instrumentalize (recuperate) any movement that might undermine its continual expansion. As such, it is indicative of our need to not rely on grassroots movements that promise freedom from our current capitalist system but instead directly address the political and institutional frameworks that allow that system to continue. Closing his argument, he writes:

> A reluctance to talk about institutions and political change doomed the Arts and Crafts movement, channelling the spirit of labor reform into consumerism and D. I. Y. tinkering. The same thing is happening to the movement's successors. Our tech imagination, to judge from catalogues like "Cool Tools," is at its zenith. [...] But our institutional imagination has stalled, and with it the democratizing potential of radical technologies. We carry personal computers in our pockets – nothing could be more decentralized than this! – but have surrendered control of our data, which is stored on centralized servers, far away from our pockets. The hackers won their fight against I. B. M. – only to lose it to Facebook and Google. (Morozov 2014)

While Morozov's critique is prescient, it ignores the underlying principles of the maker movement, which do seem less apparent in the popularized and corporatized version but which remain vital to many academic and artistic communities. Morozov accurately situates the rhetoric that launched this DIY revolution at the intersection of the radical hippie ideology and Silicon Valley fuelled techno-utopianism of 1960s and 1970s, California. In this contextualization, Morozov focuses on Stewart Brand's launch of the *Whole Earth Catalogue*, as a hawker of technologically informed, hippie lifestyle accoutrement and an ambassador of the "hacking" brand/rhetoric. But, in so doing, Morozov simplifies the rhetorical vector he is criticising and ignores a much older discourse around humans and making which ultimately allows for the emergence of artistic practices which share affinities with and are often inspired/informed by tactical/radical media as well as critical design, making and engineering – each of which critically engages technologies as contextualized within a techno-social milieu and, through a process rooted in "making," is able to discover, draw attention towards and potentially repair inconsistencies within the techno-social systems they engage.

Tactical media is described by Garcia and Lovink (1997) as "what happens when the cheap 'do it yourself' media, made possible by the revolution in consumer electronics and expanded forms of distribution (from public access cable to the internet) are exploited by groups and individuals who feel aggrieved by or excluded from the wider culture." "Critical design" is a term originally coined by Anthony Dunne and Fiona Raby to describe a speculative approach to design that "embod[ies] ideals and values intentionally at odds with those of [one's] own time" (Dunne/Raby 2013: 17). They identify William Morris as perhaps the first critical designer and link his work to future work of Walter Gropius and the Bauhaus (ibid). This approach to design, as a potential mode for social change, is prevalent in the utopian discourse surrounding (as Morozov notes) the arts and crafts movement but also the parallel Art Nouveau (in Europe) as realized through the *Jugendstil* in Germany and the Vienna Secession. While these movements were largely concerned with the democratizing potential of design, Raby and Dunne coined the term "critical design" specifically to address what they saw as "the uncritical drive behind technological progress, when technology was always assumed to be good and capable of solving any problem" (ibid: 34). For Dunne and Raby, the use of "speculative design proposals" could "challenge [these] narrow assumptions [...] about the role products play in everyday life" (ibid). As will be considered later, however, this approach to design as well as the use of the term "critical" to describe it – was already apparent in, for instance, Krysztof Wodiczko's 1970s "Vehicles" (Wodiczko, 1999: 77, 78) and the conceptual approach of the Emerging Art and Technology movement under cybernetics in the 1960s. Wodiczko would later found the Interrogative Design Group – another design organization focused on critical approaches. Informed by Dunne and Raby's critical model but further concerned with the specific role making can play in the process of criticality and knowledge discovery, Matt Ratto (2011) coined the term "critical making" as a

bridge between critical thinking and physical "making" (2011: 253). Specifically, Ratto distinguishes critical making from other critical practices in its focus on the process or the act of making as the site of discovery/learning as opposed to a focus on a final outcome (or object) as a critical tool (ibid). Ultimately though, the goal of critical making is to "enhance and extend conceptual understandings of critical sociotechnical issues" (ibid: 254).

Through Ratto's construction, "making" becomes clearly defined as a specific mode of production and engagement with materials. However, this understanding of the process of making was not always obvious and has not only been challenged but has been alternatively described within historical philosophy of humanity as a producer (or maker). An analysis of this historicized discourse will reveal that not only is "making" not simply a DIY approach to the production of goods (as Morozov suggests), it is – in its original construction – a philosophical (and artistic) approach to humanity's relationship with technology and the technical object. Thus, the philosophical history this paper explicates will ultimately arrive at a conceptual foundation ripe for the emergence of the type of engagement with production characterized by Ratto and his contemporaries.

Homo faber

The discussion of humanity's relationship to making begins with the Greek philosophers. Plato and Aristotle both distinguish *technê* (craft) and *épistème* (knowledge), but in slightly differing ways. Plato's Socrates suggests that while knowledge can be derived from the practice of craft, it is incomplete (not *noêsis*, understanding) without the application of higher orders of thinking or reasoning, specifically mathematics, to reveal the true form of things (Plato: 12–13). Aristotle, however, defines technê as, itself, a kind of knowledge directed at production, which is of a lower form than épistème (theoretical knowledge) (Schadewaldt 1979: 29). Technê, for Aristotle, is knowledge directed at production (Aristotle 2014: 19, 20). Hence, both Plato and Aristotle maintain a utilitarian view towards the practice of technê (making). Whereas Plato throughout *Republic* refers to technê in terms of their objectives or outcomes, Aristotle's definition of technê requires that it results in the creation of a product (or outcome) – that it be leveraged toward some end. Thus each philosopher, despite setting up a discourse between theoretical knowledge and applied knowledge also reinforces a division between the material and theoretical realms. Certainly, there are contemporary makers that are content to produce in this way, whose production is not geared towards the discovery of some underlying truth about society or culture. However, it is important to remember that while Plato and Aristotle remain utilitarian in their view and that that approach will initially be the one that is favoured, it is also as early as these two classical thinkers that we can read the beginnings of a relationship between the act of production (making) and knowledge production.

However, it is the divide between higher-level reasoning (knowledge creation) and production that, many centuries later, is reinforced and strengthened by Rene Descartes' famous aphorism, "I think therefore I am" (1641). In this assertion, Descartes privileges the role of thought in the construction of the individual, creating what is now known as "mind-body dualism." Descartes' mind-body dualism posits a real distinction between the mental and the physical body, suggesting either could (theoretically) exist without the other. This position not only frees Descartes of the problem of subjectivity (the unreliability of human perception); it also allows for the creation of a (designed and) mechanistic view of the natural world. Along with the work of Francis Bacon and Galileo Galilei, Descartes ushered in a programme of scientific rationalism, based primarily on the application of reason, that would dominate Western science as well as philosophy. This perspective, by creating an objective distance between humanity and Nature,[1] also solidifies the philosophical framework for humanity's domination of Nature through science and technology.

Ultimately, for Marx, this domination is realized through labour. However, while Marx (with Engels) and Descartes (with Bacon) share a largely positivist view towards the application of technology to society, Marx and Engels shift the Cartesian framework in some key ways which will ultimately reopen the potential for knowledge production through making as well as reemphasize making (material production) as a defining activity of humankind. Important to an understanding of how production can become a mode of realization is the positioning of humanity as a component of Nature[2] – though Marx and Engels maintain humanity's position as naturally dominating Nature. As Marx writes in *Capital*:

> The labour-process or the production of use-values labour is, in the first place, a process in which both man and Nature participate, and in which man of his own accord starts, regulates, and controls the material reactions between himself and Nature. He opposes himself to Nature *as one of her own forces*, setting in motion arms and legs, head and hands, the natural forces of his body, in order to appropriate Nature's productions in a form adapted to his own wants. (1967: 75) [emphasis added]

Marx's metaphor positions "man" as the controller in a Cartesian mind-body construction, which is made up of the entirety of Nature. However, Engels is careful to directly address mind-body dualism and to situate humanity within the construct of Nature:

> Thus at every step we are reminded that we by no means rule over nature like a conqueror over a foreign people, like someone standing outside nature – *but that we, with flesh, blood*

1 'Nature' is capitalized throughout the text to reinforce its uniqueness as the collected phenomena of the physical world (of which we are part).

2 This will ultimately become important to Cybernetic worldviews.

and brain, belong to nature, and exist in its midst, and that all our mastery of it consists in the fact that we have the advantage over all other creatures of being able to learn its laws and apply them correctly. And, in fact, with every day that passes we are acquiring a better understanding of these laws and getting to perceive both the more immediate and the more remote consequences of our interference with the traditional. In particular, after the mighty advances made by the natural sciences in the present century, we are more than ever in a position to realise, and hence to control, even the more remote natural consequences of at least our day-to-day production activities. But the more this progresses the more will men not only feel but also know their oneness with nature, and the more impossible will become the senseless and unnatural idea of a contrast between mind and matter, man and nature, soul and body, such as arose after the decline of classical antiquity in Europe and obtained its highest elaboration in Christianity. (Engels 1954: 83, 84) [emphasis added]

Here we see both a rejection of the Christianity behind Descartes' mechanistic worldview but also a strengthening of humanity's position in domination of Nature. Finally, in both of these selections we can read another key shift from Cartesian thinking: the primacy of human labour in the construction of the individual. For Engels, labour is even responsible for humanity's evolution from its primate ancestors (ibid). But reason is not discounted in the Marxian analyses; in fact, it is reason that distinguishes the labour of humans from the productive work of other animal species. Specifically, for Marx, concepts created first in the mind are then constructed through labour and are put to work towards the ultimate goal of humanity's domination of Nature. It is this preconstruction of the technical object in human consciousness that, for Marx, distinguishes humanity from the other animals (1967: 74). With Marx, we arrive at *homo faber* (man-making), or humanity defined by its production. Moreover, humanity is defined not only by its production of objects (in general) but by its production and use of tools, geared at its domination of Nature.

Homo faber certainly lays the foundations for the lofty rhetoric of maker-dom in the following century. However, this instrumentalist (or utilitarian) definition also reveals inherent antagonisms that foreshadow Morozov's frustration. Lewis Mumford, in his "Tool Users vs Homo Sapiens and the MegaMachine" (notably, written in 1966), directly critiques Marx's prioritization of tool-making. For Mumford, such a prioritization not only leads (ultimately) to a stagnation of human development (1966: 381); it also entirely discounts "human prehistory in which a decisive development actually took place" (language) (ibid: 383). Mumford herein returns to a primacy of humanity's mental acuity but does so through a focus on humanity's development of symbolic systems, specifically language, but including the arts. In support of this position, Mumford reminds us that the Greek *technê* made no distinction between the production of technical artefacts and aesthetic ones (ibid). Mumford complains that "our age has not yet overcome the peculiar utilitarian bias that regards technical invention as primary, and esthetic expression as secondary or even superfluous" (ibid). Furthering his

argument, Mumford directly critiques a central inconsistency in Marxian philosophy: namely, the desire to free humanity from alienated labour through the continued production of increasingly complex machines and tools of production. Mumford asks:

> If man indeed owes his intelligence mainly to his tool-making and tool-using propensities, by what logic do we now take his tools away, so that he will become a functionless, workless being, conditioned to accept only what the Megamachine offers him: an automaton within a larger system of automation, condemned to compulsory consumption, as he was once condemned to compulsory production? (ibid: 387)

In closing then, Mumford proposes an alternative position, that – in fact – humanity's potential can be fulfilled through the embrace of humanity's less utilitarian instincts, to allow "play and work" to "form part of an organic cultural whole" (ibid: 388). Mumford calls for a "liberation *for* [as opposed to *from*] work, for more educative, mind-forming, self-rewarding work" (388). Here, then, Mumford presents two discourses regarding *homo faber,* whose influences can be directly seen in the construction of both the hippie ideology and, in turn, the "California Ideology" (the particularly utopian perspective on technology forwarded by early technologists, specifically in Silicon Valley in the 1960s and 1970s). First, Mumford represents a linguistic turn – that is a turn away from defining humanity in terms of production and instead towards defining humanity in terms of linguistic systems of signification. This perspective will strongly influence the conceptual art movement as well as the shifting definition of the technical "object" (or objects in general) under postmodernism. Second, for Mumford, these systems of signification also represent a non-utilitarian realm of human activity, which he considers an aesthetic (or artistic) realm.[3] Finally, this realm of human production (as anti-utilitarian) is characterized not by the fabrication of products (specifically, tools) but instead by a process that integrates creativity and play towards a prioritization of individual self-actualization.[4]

It is Mumford's call for playful and self-actualized work that seems to be directly answered in the approach forwarded in the 1970s' birth of the maker movement. This move towards "playfulness" to describe one's engagement with

3 Here, Mumford's association is certainly parallel to Rancière's conception of an "aesthetic regime of the arts" (2010). Considering the relationship between the two, the reader will be more likely to see the direct parallels that form between 'hacker' culture and artistic production.

4 While not explicitly cited, readers here should recognize a number of rhetorical and ideological positions adopted by the anti-war movement of the 1960s and 1970s. Most acutely, the ideological shift towards self-actualization (particularly through playfulness), which will define much of the (seemingly) hedonistic tendencies of the anti-war and ecological movements of that period.

production is reflected throughout the emancipatory rhetoric and practices of the technologist culture in the 1960s and 1970s. As Turner (2006) recognizes, Stewart Brand (whose *Whole Earth Catalog* is associated with the foundations of the current maker movement) saw in the technological achievements of computer gamers and AI researchers "countercultural pioneers" who were "inventing a new, collaborative, play-oriented culture [...] in the *Whole Earth* tradition" (2006: 116, 117). These "hackers,"[5] "who invented for pleasure" as distinguished from "planners," "who pursued problems according to a set and less flexible strategy" were, for Brand, "not mere 'technicians,' but 'a mobile new-found elite, with its own apparat[us], language, and character, its own legends and humor'" (Brand qt. in Turner 2006: 117). This primacy of "play" is even reflected in Dunne and Raby's characterization of their speculative approach as a "methodological playground" (2013: 69). Pekka Himanen explores this emergence of play in *The Hacker Ethic*, wherein he contrasts the "hacker work ethic" to the "Protestant work ethic." Himanen Torvalds and Castells draw this Protestant work ethic from Max Weber's essay "The Protestant Ethic and the Spirit of Capitalism" (2001: 8). Whereas Weber describes work as moral, as a duty and – ultimately – as an individual's expression of their godliness, Himanen describes work (as experienced by hackers) as joyous, playful, and fulfilling (ibid: 4). Drawing on anecdotes from the hackers at MIT and in Silicon Valley during the 1960s, Himanen suggests an approach to work that is characterized by "the dedication to an activity that is intrinsically interesting, inspiring, and joyous" (ibid: 6). Furthermore, Himanen and Linus Torvalds (a leading figure in the open-source movement), in describing the motivation of hackers within the text, shift the focus away from monetary compensation and towards the sheer entertainment value of solving a presented problem, as well as the social value of "peer recognition" (quoting Raymond from *The Cathedral and the Bazaar*[6]) (ibid: 51). Herein, what Mumford characterizes as "aesthetic," Himanen characterizes as "hacker"; Mumford's artist becomes Himanen's hacker, or (more correctly) both the artist and the hacker are recast as the philosopher. This perspective is also reflected in Brand's understanding of the burgeoning movement, but Himanen's characterization becomes most apparent through his tendency to regularly draw parallels between his "hacker" model of work and an idealized version of Plato's academy. Himanen characterizes the work

5 It should be understood that in this era, which would ultimately give birth to the 'maker movement' terminological distinctions between 'hackers' and 'makers' were not clear. Furthermore, within this specific subset of the maker community, such distinctions remain unclear as exemplified between the cross-over activities of hacker and makerspaces globally. For instance *Noisebridge*, in San Francisco, is described as both a hacker and makerspace (https://www.noisebridge.net/).

6 *The Cathedral and the Bazaar* is a book by Eric Steven Raymond which investigates and defends open-source software production. In the text, Raymond likens open source to "the bazaar" and closed, hierarchal models to "the cathedral."

of hackers as synonymous with the higher-order conceptual work of the philosopher (in contrast to the artisan) in Plato's model.

Hannah Arendt (1998) laments this shifting up of human activity, arguing that in so doing, *homo faber* is actually deprived of its essential nature:

> Nothing perhaps indicates clearer the ultimate failure of *homo faber* to assert himself than the rapidity with which the principle of utility, the very quintessence of his worldview, was found wanting and was superseded by the principle of "the greatest happiness of the greatest number." [self-actualisation] When this happened it was manifest that the conviction of the age that man can know only what he makes himself [through experimentation] – which seemingly was so eminently propitious to a full victor of *homo faber* – would be overruled and eventually destroyed by the even more modern principle of process, whose concepts and categories are altogether alien to the needs and ideals of *homo faber*. (1998: 402)

From this quote, we can extract three basic premises of Arendt's criticism. First, Arendt identifies what she refers to as a "reversal of hierarchy within the *vita activa*" or this shift upward of production from the realm of technê and into the realm of épistème (Arendt 1998: 401). Second, referring back to Descartes, Arendt locates the origin of this reversal in the empiric turn that left philosophy "condemned to be always one step behind the scientists and their ever more amazing discoveries, whose principles it has strived arduously to discover *ex post facto* and to fit into some over-all interpretation of the nature of human knowledge" (ibid: 396). Finally, Arendt notes that the scientific process is in fact a process of reaching understanding through creating imitations (models) of Nature's processes (397). Thus, "the shift from the 'why' and 'what' to the 'how' implies that the actual objects of knowledge can no longer be things or eternal motions but must be processes" (ibid: 397). And so, for Arendt, "in the place of Being we now find the concept of Process" (ibid).

Ultimately Arendt's criticism is a response to the existential crisis she identifies as springing forth from the demise of *homo faber*. As a result, Arendt calls for a return to pure thought, to consideration as an end in itself. However, in conjunction with the aforementioned linguistic turn of Mumford, it is precisely this shift from the "why" to the "how," via the "what," that provides the foundation for conceptual art – while also introducing an antagonism between process and object to the sphere of cultural (aesthetic) production. Moreover, this antagonism between process and object ultimately provides the foundation for Fine Art's dismissal of technologically informed artistic practices. And consequently, through this dismissal, it obfuscates those practices which bridge the arts and the hacker communities – as a result of their being intimately bound to early hacker culture and conceptually dedicated to a parallel ideological structure as their Fine Arts (conceptual art) counterparts. In order to fully unpack this antagonism and to re-establish the bridge between these practices, we must further investigate the philosophical and scientific developments that underpin the shift from *Being* to *Process* that Arendt identifies.

Cyborg selves or technology as process

Foremost in this analysis, it is important to further unpack *homo faber's* relationship to its environment, which I will do through the phenomenology of Heidegger. This understanding of a more nuanced relationship between humanity and its environment (including both technology and Nature) establishes a framework for understanding the Cybernetic turn, which will largely influence the thinking of the early technology (maker and hacker) movements. While Marxism situates humanity within Nature, it also situates humanity (by means of humanity's cognitive ability) as the marshal of Nature, charged with the responsibility to mould Nature to suit humanity's needs. Marxism elevates *homo faber* as humanity's ultimate purpose, making – out of Nature – humanity's tools for the further control and moulding of Nature. Heidegger does not deny these premises, arguing in "The Question Concerning Technology," that the instrumentalist approach to technology is true, but not complete. However, Heidegger significantly shifts the means by which the relationship between humanity and Nature is constructed, providing a framework for a new mode of understanding of what it is to "Be," and how that which is external to one's "Being" participates in the definition of one's "Being." For Heidegger, in *Being and Time*, "Being" *(Dasein)* is always contextual, "Being-in." Negating Descartes' construction, Heidegger proposes that the world is always *experienced* before it is defined. "Being-in," or contextualized experience, therefore precedes the revelation of the essence of a thing.

This pre-eminence of experience, which is the foundation for phenomenological (and post-phenomenological) accounts of the world, is supported by our relationship to technical objects. Again in *Being and Time*, Heidegger outlines three modes through which we experience the technical object. The first mode of the object, "readiness-to-hand," is the use-mode of the object. In this construction, the object in use reveals to us its "true" essence, which is its purpose and its use. Furthermore, within this mode, the object, as an object external to us, disappears. This disappearance has two effects: first, the thing-ness of the object – its external, formal qualities – becomes transparent through the process of revealing its use value as its essence. Second, through this disappearance of its external attributes, the object incorporates itself into a collective individual which is now the new ontological truth of the individual. The human hammering is not a human and a hammer but is instead human/hammer, hammering; the hammer extends the human. This mode is contrasted against "presence-at-hand," which is the mode in which the object is not in use and can reveal only its external attributes and not its "truth:" its use value. Furthermore, "readiness-to-hand" is also contrasted with "unreadiness-to-hand." "Unreadiness-to-hand" describes those situations in which the technology fails in its use and thus breaks its coterminous relationship with the individual and (shockingly) reveals itself as "present-at-hand," merely collected physical attributes. This rather concise summary of only a small portion of Heidegger's approach allows us to situate within Heidegger's ontology

the necessary philosophical underpinnings for a socio-relational approach to technical objects. There are, then, three main considerations brought about in Heidegger's approach which redefine our perspective towards *homo faber*.

To begin, the idea of transparency and extension explicated in Heidegger's tool use leads to cyborgian construction of the self, wherein technologies are always, already implicated in our very being. This framework will be reinforced by cybernetics in the mid-20th century and will greatly influence the thinking of Marshall McLuhan (among others) by the 1960s. Second, this perspective on tool use shifts the focus of the discourse on technology away from technology as an object for consideration outside of the individual and toward an analysis of technology's essence, which is revealed through use but also *is* the specific (intended) use (value) of the technology. Upon this framework I will build a number of different considerations regarding the mode by which the technical object comes into existence, how it translates function into form and how through so doing it also discloses all other forms (and functions) it may have taken. Finally, in "The Question Concerning Technology," Heidegger suggests that technology is actually, itself, a mode of revealing. Building on the first two premises presented here, I will consider how technology can be a mode of revealing, what technology does reveal and how that function of technology can be used to greater understand our social and technical contexts.

Now, it is almost impossible to consider machines as simply tools through which we enact our individualized wills. Instead, machines (technologies) implicate themselves in our mental processes, our bodies and (hence) our very being. However, the 1960s represented the forward cusp of this future integration of technological apparatus into every aspect of our lives. As such, predictions, responses and positions towards the potentials of technology were various. One strong technical and cultural influence on that potential future came from the field of cybernetics. Cybernetics is an area of scientific research concerned primarily with command-and-control functions in complex systems. In 1948, Norbert Wiener published *Cybernetics: or Control and Communication in the Animal and the Machine*. Recalling Arendt's position that the role of science was to replicate Nature, the goal of cybernetics was to engineer more complex computational systems through inspiration provided by the complex systems already existing in Nature. The cybernetics approach, ushered in by Wiener's text in conjunction with a paper by Claude Shannon entitled, "A Mathematical Theory of Communication," signified a radical break with previous mechanistic approaches. Cybernetics described a system of feedback loops, wherein component parts adjusted their activity based on positive and negative feedback, keeping the system in balance. This approach flipped the hierarchal structure envisioned by a mechanistic view, where regulation was not controlled by a bottom-up process of self-correcting interactions but instead by a "grand designer" of a fully realized mechanical system. However, this bottom-up approach requires a clear understanding of information and its transfer between component parts of the system, as it is that communica-

tion within the system which allows the system to self-regulate. Hence, Shannon's mathematical approach to information proved invaluable because it established a mathematical model of information based on a distinction between signal (the message) and noise (the corruption of the signal introduced during the process of transmission). Most important to Shannon's construction is that the content of the message is not important to the mathematical model, which is based solely on the fidelity of the signal over the course of its transferral.

Cybernetics, which, as a result of its systems-based approach was intentionally interdisciplinary, excited many philosophers and artists just as it did scientists. By the 1960s, cybernetics-based ideas had become commonplace within the culture as can be witnessed in the media theory of Marshal McLuhan, which strongly influenced the conceptual art of the 1960s and 1970s – as exemplified by regular references to his work in texts surrounding *Information*, the 1970 Museum of Modern Art exhibition (Allan 2004) as well as critical designers like Krysztof Wodiczko (1999: 193). McLuhan's famous aphorism "the medium is the message" (1964) is a direct reference to Shannon's theory of information and ushered in an entire field of media studies based on the relationship between the content of a message and its packaging. In addition, McLuhan's construction of individuals extended through technological prosthesis, while hearkening back to a Heideggerian understanding of "readiness-to-hand," is also supported by the cybernetic construction of individuals as components in larger systems. Cybernetics also influenced the techno-hippie culture of Haight-Ashbury. Richard Brautigan's 1967 poem "All Watched Over by Machines of Loving Grace" is a notable example of the cybernetic influence in that it describes a world wherein computation (computers), through cybernetic understandings, becomes the bridge between Nature and humans (ostensibly alienated from Nature by the machine of production). The poem does this by recalling such images as "a cybernetic meadow / where mammals and computers / live together in mutually programming harmony / like pure water / touching clear sky" (1967). Within this cybernetic landscape, Brautigan ultimately envisions humanity's emancipation from labour altogether, where we are "joined back to nature / returned to our mammal / brothers and sisters, / and all watched over / by machines of loving grace" (1967). Brautigan's poem is particularly apt in that it includes, in this final stanza, a techno-utopian stance towards labour that recalls Himanen's "hacker work ethic" and places itself in direct opposition to a Marxist understanding of labour as humanity's natural domination over Nature. Hence, Brautigan's poem models the fully constructed cybernetic utopia that fuelled the imagination of both the back-to-nature hippies and the DIY technologists and tied together this (seemingly) unlikely merger. Returning to this ideology's influence on the development of maker culture, as Morozov (2014) does mention, cybernetic understanding of design and systems theory also inspired Brand to produce the *Whole Earth Catalog* in 1968. As Dubberly and Pangaro note, Brand was strongly influenced by Buckminster Fuller's notion of a "comprehensive designer, [as] 'an emerging synthesis of artist, inventor, mechanic, objec-

tive economist and evolutionary strategist'" (Fuller quoted in Dubberly/Pangaro 2015: 9). The *Whole Earth Catalog* was more than "a self-published manifesto for a do-it-yourself lifestyle" (as Morozov implies); it was also "a utopian counterculture toolkit [...] [and] an introduction to systems thinking and design" (ibid: 8). Actually, for Dubberly and Pangaro, the *Whole Earth Catalog* represents a "bibliographic tour-de-force" in its coverage of classic texts in design and cybernetics (ibid: 9). Combined with the hacker work ethic described by Himanen, it becomes clear that the origins of the maker movement actually reside in the cultural culmination of philosophy's inquiry as to humanity's position in relation to Nature and the interrogation of technology's role in that relationship.

Modes of critique

At this point, we have arrived at a philosophical and cultural landscape ripe for the rise of a specific mode of production, which was championed by Brand (and others) and which establishes the theoretical underpinnings of critical approaches to technology and making seen in critical making and tactical media. In the remaining sections, I will look at specific artworks and trends within Fine Art that reflect these ideologies in order to identify modes by which those practitioners enact the criticality supported by the previously explicated theory/philosophy. Specifically, I will look at two distinct categories of critical engagement: imitation/modelling and misuse/reuse.

As mentioned earlier, the community that spawned cybernetics-based practice was interdisciplinary, with many members travelling through art, science, design and philosophy. Gordon Pask is one such member who was present from the very beginning. A scientist initially, Pask developed his own dialectic model, "Theory of Conversations," to explain learning and spent time in cybernetic research centres such as the *Biological Computing Laboratory* (Dubberly/Pangaro 2015: 6). Pask was also interested in art and design and participated in a key exhibition which was indicative of the cybernetic turn and which highlighted the cross-pollination between artists, scientists, philosophers and engineers. *Cybernetic Serendipity* was an exhibition held at London's Institute for Contemporary Art in 1968 (the same year as Brand launched the *Whole Earth Catalog*). The ambition of the exhibition was immense as the organisers set out to include in the exhibition all of the artists and engineers (internationally) working creatively with cybernetics (Reichardt 2008: 81). While unable to actually present all the practitioners in the field, as a result of its incredibly inclusive curatorial remit, *Cybernetic Serendipity* included an immense variety of artworks, installations and performances such as software, engineering projects, early robotics and human-generated drawings which followed the theme. By not focusing on only computer-generated work, the exhibition was able to fulfil its interdisciplinary aims to "explore the relationships between technology and creativity" (MacGregor 2008: 91) – a remit one sees repli-

cated in today's maker fairs. Finally, as the exhibition organizers did not display computational works outside of their computational contexts, but also displayed them alongside similarly inspired, human-generated work, it created a discourse between technology and creativity, science and art (ibid). Gordon Pask's piece, *Colloquy of Mobiles* – particularly when placed in dialogue with Marcel Duchamp's 1923 work, *The Bride Stripped Bare by Her Bachelors* (or *The Large Glass*) – is a prime example of the move from a mechanistic worldview towards a cybernetic one. Both of these pieces also show how the creative productivity resulting from the cybernetic discourse was largely in parallel with the discourse of conceptual art and reveal the first mode of engagement associated with criticality in art, design and making.

Duchamp is generally considered to be the father of conceptual art. In his late work, *The Bride Stripped Bare by Her Bachelors* – which should be accompanied by a book of notes explaining its iconography and mythology – Duchamp presents an artistic rendering of a speculative mechanism which diagrams an encounter between the bride and her nine bachelors. This rendering is created through the application of wire, foil and dust to two panes of glass, placed, free-standing, atop one another to create a double-paned window of greater than 9 ft. The upper portion is referred to as the Bride's Domain, while the lower portion, the Bachelor's Apparatus. The work's inclusion of a speculative text, the engineer's notes as well as the audience's participation (in that viewers can see each other through the glass as well as their own reflection in it) all point to the beginnings of a systems-based approach, reflect the speculative angle which will later appear in Dunne and Raby's approach and point towards the primacy of process championed by Matt Ratto. Yet, Duchamp's speculative translation of the social encounter into a mechanical device also recalls the mechanistic worldview that remained dominant in the 1920s. Forty-five years later, however, Pask approaches a similar theme from a cybernetic perspective. Whereas Duchamp renders plans for a speculative machine, Pask actually creates such a device (the method championed by Ratto, Dunne and Raby and Wodiczko). In *Colloquy of Mobiles*, Pask creates a light-based discursive interaction between two sets of forms. The forms, which are divided into two types (male and female), communicate and interact through a series of simple rules. With these rules, Pask creates a system in which male forms must compete with each other to gain (and hold) the attention of female forms. Finally, audience members can interfere with the interactions by blocking light messages between forms or by injecting their own light sources into the system. Like Duchamp, Pask's discussion of the work remains completely in the realm of technical description. Furthermore, Pask does not refer to, or indicate, any symbolism within the work or similarity the work might bear to human social encounters (Pask 1968). However, thematic similarities between the works are immediately apparent. With these two works, we see the social interaction of courtship represented first as a complex mechanism and then as a cybernetic system. In each, the intricacies of the systems presented remain opaque, too

complex to grasp at a given moment, but pointing towards the knowledge that is the underlying structure of the presentation revealing its truth. However, Duchamp's adherence to diagrammatic and textual signification, which would become a defining element of Conceptual Art later in the century, lies in stark contrast to Pask's material realization (his making) of the (still representative) system.

With this disconnect between the two practices, we see the antagonism between semiotic (or linguistic) modes of representation championed by conceptualists and the material approaches performed by the art-and-technologists – which would, ultimately, keep the art and technology out of the dominant narrative of Fine Art's progression. It is towards this omission that Edward Shanken has largely devoted his art historical career, regularly drawing attention to the parallel ideologies of these contemporaries. As Shanken notes, both artistic methodologies engaged in meta-critiques of aesthetics and society through the application of systems-thinking. Though, while the technologists focused on technological systems and apparatuses, the conceptualists focused on linguistic networks of signification and knowledge structures. Conceptualist critics of the Art and Technology movement pointed towards the movement's foregrounding of technological media as an indication that the movement was dominated by materiality and, as such, could be reduced to mere "spectacle" (Shanken 2002). However, it is that very foregrounding of production and materiality that links this artistic movement to contemporary maker culture.

However, in ignoring the material component of the cybernetic approach, the conceptualists are unable to address a number of key philosophical and ontological problems that arise within the techno-social paradigm at the level of the integration of the technology into the individual. Instead conceptual art's focus on language leads to the ungrounded intertextuality that would come to define Jameson-ian (at least) postmodernism, and which Jameson characterizes as "schizophrenia" (Jameson 1991: 4). In contrast, art and technology, by accepting the material cyborgian relationship developed by Heidegger and supported by cybernetics, also accepts that the resulting cyborg body must include the underlying logic both of its organic birth and of its technological prosthetic. Herein, at the level of the integration, art and technology is able to interrogate ramifications of the integration of the socially constructed essence of a technological artefact into a functioning whole.

Directly addressing this core essence of the technological object, Gilbert Simondon develops, in *The Mode of Existence of Technical Objects*, a process by which technology is concretized by the continual reintegration of previously concretized technological instances. In each of these moments of integration the component parts rationalize one another to such an extent that their mutual functioning achieves peak efficiency and neither can fully function any longer outside of the merger. By combining this understanding of the development of technical objects with a return to Heidegger's readiness-to-hand, we realize that technological objects continue this process of obscuring on many levels. In order

for a technology to remain in the state of readiness-to-hand and to not devolve into *unreadiness-to-hand* – not break the phenomenological continuity experienced between the self and the object – the interface (the point at which the self and the object meet) must be transparent. As Galloway notes throughout *The Interface Effect* (2012), we consider superior functioning technologies to be those technologies that produce the greatest level of transparency. But, as Galloway also argues, increasingly smooth interfaces achieve their transparency through making assumptions about the user. These interfaces begin to undermine the agency of the user by training the user to engage in a particular, predefined way. Therefore, the most basic mode of critically engaging these systems, which is present in both conceptual and the technological traditions, is simply the act of revealing the system as such. This is the level at which Duchamp and Pask engage, which draws our attention to the idea that there is some truth or some intention driving the seemingly smooth interface we encounter.

Understanding Simondon's construction of the technical object's internal coherence, we can now turn our attention to Latour's shift in focus away from internal coherence and towards the mode by which intentionality is socially imparted to the technical object. For Latour, the construction of a technical object is actually the reification of "techniques" (processes). He refers to this process of reification as "shifting-down" or "delegation." Through this process, the object allows the originator to remain present, in perpetuity, enacting their intentionality on the world for as long as the technical object remains in use (1994: 29–64). Referring back to Simondon, this process by which intentionality is captured within tools is also the process by which the technical object becomes individuated and evolves. The object does not represent but *is* the collected intentionality of all the individuals who have contributed to its construction. This is the mode by which we are able to offload our own functions onto technologies (again recalling a McLuhan-ist understanding).

But this process of transcoding does not always yield expected results; sometimes our intentions are overly simplified or otherwise mistranslated in the final object/process. Hence, another artistic intervention into this space of technological offloading reveals a technological system through its inability to produce rational or expected outcomes. *Molleindustria*, an Italian culture-jamming site, creates online flash games and machinima which critique social structures through a game interface. One game, *To Build a Better Mousetrap* (2015), casts players as cats set upon the task of discovering an ideal management algorithm for the allocation of labour resources within a factory. In this example the critique is levied on both the narrative and structural levels. By embedding Fordist principles into a game system, which we already intuit as a simplified model of a lived experience, *Molleindustria* reveal the potentially negative outcomes of widespread adoption of those simplified policies (neoliberalism). However, through embedding one system in the other, *Molleindustria* also reveal that capitalism, Fordism and the neoliberal approach are all, in fact, technologies. It is this ability to experientially

and materially embed technological systems within the art that gives making, as an artistic approach, its strength. This is because, through the process of embedding the system into the work, the artist is able to directly expose the audience to the inconsistencies of the technological systems being critiqued – as is the case in the *Molleindustria* example mentioned earlier as well as a theoretical foundation for glitch art (which will be discussed further under the method of misuse). As Mark Nunes writes, "*error* provides us with an important critical lens for understanding what it means to live within a network society. Error reveals not only a system's failure, but also its operational logic" (2010: 16). In the *Molleindustria* example, the banality of the management experience and the frustration of the player as a result make manifest the alienation felt by those who are embedded within seemingly inevitable technological structures, like capitalism.

This social acceptance of the inevitability of the form a specific technology takes is potentially one of the most dangerous fallacies we face in our technological engagement. However, it is a common occurrence as we face fully concretized, melded technological objects. These objects present themselves to us as completed, fully efficient, unimpeachable representations of their purpose. This inevitability is reinforced by the mode by which the object, itself, becomes a communication. Tiziana Terranova (2004), in the first chapter of her book, *Network Culture: Politics for the Information Age* applies Shannon's theory of information to an analysis of intentionality in the technical object. Through this process, Terranova draws our attention to the fact that within the process of distinguishing between signal and noise, we necessarily foreground one portion of a communication, while characterizing the other as irrelevant. Through this process of demarcating the relevant and irrelevant, we construct the field of possibility – all possible forms and values the transferred information can take. This field is not neutral, as those values which remain outside of the field are excluded not just from the communication in question but from the known universe as a whole. From the perspective of the user, then, these potential transmissions or outcomes cease to exist (Terranova 2004: 6–27). Thus the technical object itself, through this process of definition by exception, becomes a communication of that which the toolmaker has accepted as possible (reveals the intentionality of the toolmaker) as well as that which we, as a whole, have accepted as possible. However, critical making (in both artistic and educational realms) disrupts this process by challenging the toolmaker to consider and explore these alternative possibilities.

The previous two artistic approaches reveal systems through a process of imitation or modelling. The next two modes of engagement misuse or reuse existing technologies in order to disrupt our acceptance of the technological object – either through the subversion of its original use or the presentation of potential alternative uses. Identifying alternative applications for a given medium is a traditional artistic approach, particularly since the rise of modernism, when painters directly addressed the previously assumed role of the canvas a central component of the work. However, even earlier examples of artists pushing the boundaries of image-

making technologies include renaissance explorations of alternative forms of perspective and optical illusion. "Glitching" is an artistic approach by which, as glitch artist Rosa Menkman suggests, artists can directly address the signal/noise relationship and "elucidate and deconstruct the hierarchies of digital technologies" (2010: 340). Glitch artists create intentional glitches (faults) within media, software or interactive systems, intentionally creating an "unreadiness-to-hand" for poetic effect. For Menkman then, it is "with the creation of breaks with the political, social, and economic conventions of the technological machine, the audience may become aware of its inherent preprogrammed patterns. Then, a distributed awareness of a new interaction gestalt can take form" (ibid). In her own work, *Collapse of PAL* (2010), Menkman uses glitching effects to performatively re-enact the "murder" of PAL (an analogue video protocol) by the full adoption of digital formats. The work then not only reveals the logic of PAL but, more importantly, reveals the seeming inevitability of technology's forward progression. Finally, the work reminds us that PAL still exists as an artefact, slowly degrading, as well as within the construction of its digital replacement.

Glitching as an approach is an extension of the relationship to technology originally born in the 1960s and 1970s (as hacking) and also a realization of the type of critical engagement with technology forwarded by Ratto and Garnet Hertz (an artist, educator and designer who continues in Ratto's critical-making tradition). Much of Hertz's artistic and theoretical work also uses the methodology of misuse and reuse to draw attention to the underlying structures of a particular media artefact. In "Zombie Media" – written with Jussi Parikka – Hertz draws out the relevance of reuse and misuse in terms of media archaeology geared at critiquing the planned obsolescence of media artefacts (like presented in Menkman's work): "[M]edia archaeology becomes not only a method for excavation of the repressed, the forgotten, or the past, but it extends itself into an artistic method close to Do-It-Yourself (DIY) culture, circuit bending, hardware hacking, and other exercises that are closely related to the political economy of information technology" (Hertz/Parikka 2012: 425). Another contemporary of and collaborator with Garnet Hertz is Benjamin Gaulon, whose text "Hardware Hacking and Recycling Strategies in an Age of Technological Obsolescence" is featured in Hertz's critical-making book project of the same name (2012), along with the work of previously mentioned Mitch Altman, Dunne and Raby, the Critical Engineering manifesto and others.

Gaulon's ongoing project, *Recyclism*, focuses on reuse as opposed to misuse (explicitly). While misuse and reuse can often blend into each other, there are some key differences in the mode of engagement with the technology in each case. Reuse, while often presenting a speculative or alternative application of the technology, again, breaking down our acceptance of technology's predetermined trajectory brings an ecological perspective to the work (as highlighted by "Zombie Media"). Reuse broadens the frame of a systems-based view to implicate the viewer also in the ecological damage our current rampant production and discard of technology engenders. An early example of Gaulon's approach is the *Recycling*

Entertainment System (RES) (2004). RES repurposes *Nintendo* game controllers to create a collaboratively played midi instrument. The work both points to alternative uses of technology and calls for a social experience of technology. This work exemplifies many of the tenets of relational art practice made possible through the application of technological systems. This collaborative direction is also reflected in Gaulon's dedication to open source and in the fact that all of his works are open source. The art becomes even more of a social process with both a technical and an art-going audience.

Conclusion

In conclusion, it should have become apparent that while the broadly popularized "maker culture" associated with corporate entities like *Maker Media* or *Maker Fair* certainly has a questionably capitalist agenda, under that same cultural umbrella (and derived from the same originating philosophical ideologies), one can find artistic and philosophical approaches to technology and labour. These are rooted in playfulness and critical engagement. This mode of production is brought forward by the examples presented here (Menkman, Hertz and Gaulon) as well as many others such as the *Critical Engineering Group* (Danja Vasiliev and Julian Oliver). They apply a specific, post-Marxist approach to labour directed toward the philosophical interrogation and disruption of our expectations regarding technological objects. These practitioners, reflecting back to their roots in Cybernetics-inspired practices of the 1960s and 1970s, remain interdisciplinary and create works which oscillate between Fine Art, design, science and critical political intervention (in the case of tactical media specifically). Furthermore, in terms of their relationship to labour and to the role of "making" as a function of our shared humanity, these practitioners are engaging with a discourse rooted in classical conceptions of material and knowledge production, which continue to be developed as we co-evolve with our technologies, and which are continuously explored in both Fine Art and popular culture contexts.

These practices, through the criticality of their approach, manifest a number of modes of interaction which reveal underlying systems as well as their inconsistencies through modelling, misuse, reuse, deconstruction and reconstruction. The approaches and works reviewed in this text are far from comprehensive. However, I hope that by discussing these modes of interaction, I have revealed a critical approach towards technology that – through material interrogations of that technology at the level of interaction – sheds light on a systems-based understanding of technology's influence on our lives and vice-versa. Thanks to this understanding and contextualization, we can read parts of the growing maker culture as artistic and creative endeavours which continue to reveal critical insights about ourselves, our environment, our assumptions and (generally) our techno-social milieu. Finally, through this contextualization it might be possible

to understand a variety of techno-informed contemporary art approaches which do not explicitly relate themselves to maker culture, but which draw upon a parallel historical and cultural framework such as glitch art, conceptual art, Internet art and post-Internet art.

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