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[Figures not included]

Immaterial Culture? The (Un)Sustainability of Screens

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START-UP

Ours is a screen-based culture, and what we do within that culture is often inescapably screen-bound. The word "content" is used to describe the disembodied currency of our digital life—disembodied because it is both generated and consumed via a nexus of glowing screens which form the touch points of a huge technological infrastructure. In this respect all culture is to some extent becoming not just visual culture, but specifically screen culture.

This chapter critically examines our contemporary screen-based cultures of production and consumption, and some of the social and ecological implications of these new and emerging practices. It questions the dominant notion that there is social and environmental benefit to our collective shift to digital—that it is better to do it on-screen, whatever it may be. Claims for sustainability benefits often prove to be unfounded when we enlarge the boundaries of our view—electric motor vehicles may be zero emission in use, but have significant environmental impacts in their manufacture; and it of course all depends on how the electricity they use is generated.

This chapter takes an equivalent systems (even ecological) view of digital screen culture. It specifically considers how design, as an example of cultural production, is increasingly done on-screen. It then considers how our consumption of cultural content also takes place largely on-screen. It finally considers ways in which we might respond to the growing proliferation of

digital screens in our everyday lives, mindful of their potentially negative social and ecological effects.

DIGITAL PRODUCTION

Design is an activity increasingly done on-screen, be it architectural, product, or graphic design.

Contemporary architecture often bears little resemblance to what has gone before. The overtly iconic buildings designed by contemporary so-called starchitects such as Frank Gehry and Zaha Hadid are unprecedented in the history of architecture. They are the products of a new method of doing architecture—computer aided design (CAD)—in which computer modelling allows forms to be built which until recently would have been impossible to realize. The modern architect has a technical toolkit which was unavailable to her predecessors, and as a result can generate structural forms with the accompanying sophisticated engineering which actually allows them to be built. A modern consumer product may be designed almost entirely on a computer screen using computer-aided design tools, even when the outcome is to be a chair or even a building, resolutely constructed in three dimensions. Traditional draughtsmanship, whereby technical drawings were created by hand at drawing boards using pencils, compasses, protractors, set squares, and the like, has been superseded by the production of electronic drawings on-screen. The output from these software tools are electronic files which are then used for printing, machining, or other manufacturing operations. Physical manufacture and making may in this way happen only at the very end of the design process, when all design decisions have been made through virtual manipulation of form, experimentation, and iteration. The materiality of the design outcome can seem almost an afterthought—the physical realization of the design output is certainly often the quickest part of the process to execute. The pejorative term “paper architect” was used to describe Hadid in the early phase of her career, in which her architecture was never actually built. Instead, her designs for buildings were exhibited

as works of art inside those existing buildings occupied by major museums. If the only truly sustainable building is the one which is not built, then Hadid could lay claim in her early career to being the world's most sustainable practicing architect. Both engineering confidence and public taste took time to catch up with Hadid's digitally served architectural imagination, ensuring the most environmentally efficient mode of construction: not building. In this sense, digital design tools, by dint of being in advance of the means and conditions of production, actually prevented the architect from seeing her designs realized, though this was surely not the intention at the time of the developers of those tools. The fantastical creations of Hadid and her peers, with their primary focus on surface and form, often have scant regard for considerations of sustainability, in which case we might argue they are best left unbuilt in terms of the current discussion.1 Digital design which precludes subsequent production is very sustainable, in this sense.

If we must build and make, then we should strive to do so as efficiently as possible. The advent of mobile or domestic 3D printing technologies such as Makerbot means that the designer may never actually see a physical embodiment of her work—consumers will download the electronic files and manufacture the object themselves using their own equipment. In this case design and manufacture are entirely dislocated as activities, linked only by the discreet passing of an electronic file from designer to consumer. For the designer, the originator of the file, the product may never exist except in its primal virtual domain, as a disembodied arrangement of instructions to be read by a making machine at the other end of a broadband connection. At-home, print-on-demand product manufacture promises to be a much more efficient way of producing things than the current practice of manufacturing products in mass volume and then trying to sell them via a huge marketing effort.

Designing for one-time construction or bespoke manufacture promises to have the same benefit. "California studio smith|allen has completed the world's

first architectural structure using standard 3D printers," composed of 585 individually printed components made from a single material, assembled on-site.2 (see Figure 1) The creators of Echoviren do not make any exceptional claims for the sustainability or otherwise of their project, yet it essen tially embodies the principle of minimal use of a single material, designing-out manufacturing waste. The material used is also a biodegradable plant-based bio-plastic, so the structure will decompose and in time disappear through the action of the natural biological processes of its location. The negative aspect of the project is the energy cost of the manufacturing process.

Manufacturing only what is needed, when it is needed—by the consumer herself—could, we are told, render many of the present operations of a modern manufacturing company redundant, or at least require them to be significantly adjusted. Much of the conventional machinery of production, promotion, and distribution might, on this view, simply not be needed, as the relationship between producer and consumer becomes potentially quite different. This alternative production system may therefore bring significant environmental and resource savings, as surplus manufacture, product distribution and redistribution, and marketing efforts are significantly reduced or even completely designed-out. For now, discussions focus on the 3D printing at home of, for example, spare washing machine components—there is some way to go before complex consumer electronics might be produced in the same way. Similarly, the failure rate of current technology can be high, resulting in interesting but unusable defective printed outputs. But in potentially facilitating some degree of distributed manufacture, digital designing may have a contribution to make to reducing the environmental burdens of how we make things.

Graphic design also usually begins on screen, with Adobe's Illustrator, InDesign, and Photoshop software packages the essential tools of the trade for any visual designer with serious intent. These packages create their own virtual design environments, and have their own metaphoric language of "layers" (individual design elements), "masks" (used to hide

or outline parts of an image), and “paths” (lines used to create vectors), the new lexicon of digital creation. But the strictly amateur graphic designer producing a promotional flyer for a community group homework club is equally likely to perform the task on a computer. The sophistication of the tools and the output will differ—the amateur designer is likely to favour a Comic Sans font, a busy layout, lots of colours, perhaps some clip art; the serious designer will use a Helvetica font, a spare layout, a clear information hierarchy, and subtle and integrated graphic and typographic devices. Yet for both, graphic design is a computer-based activity. Not using a computer has become a deliberately reactionary move for any graphic designer, whatever their level of proficiency or intended audience.

Much graphic design of course now also stays on-screen, published, distributed, circulated, and consumed without ever making it into print. A graphic designer’s portfolio of work may exist only in digital form, and not really suffer because of it. “Do we still need a print version?” is a query familiar to anyone involved in the creation of promotional materials. Many audiences can now be reached entirely by digital means, in these cases rendering non-digital media redundant. The traditional postal mailshot is replaced by digital communications delivered by email, cost savings and material savings going hand-in-hand. Unsolicited and mostly unwanted direct marketing (in more common terms, “junk mail”) is designed-out of the system. Deleting an unwanted spam email seems a much less profligate act then condemning an unread printed brochure to the recycling bin. The print-based environmental argument for digital marketing is of course offset by the hardware via which it is produced and distributed, the focus of this volume.

What are the implications of this change in the activity of designing, and even the role of the designer? The great benefit to the designer of the transition to electronic designing of everything from buildings to leaflets is that design variations can be easily produced, allowing for

easy experimentation. Reproduction and transmission of design outputs, in the form of digital files, are also much easier than with traditional "analogue" production. The switch to digital has reinforced the shift from design as a craft-based activity, in which the final outcome emerges from a direct manipulation of materials, often over a prolonged period, to the industrial mode of design as a prefiguring of an outcome prior to any material manufacture or construction. Industrial design is the design of products for industrial manufacture, by automated processes. The development of industrial mass-production led to design becoming a distinct activity from the actual means of production, and the emergence of the designer as distinct from the designer-maker. Design is now often a white-collar activity, generating input into the manufacturing process rather than being directly involved in that process. Digital design tools have consolidated design's status as a primarily cerebral activity, which requires an understanding of materials and manufacturing processes, but does not entail a direct role in physical making. This is a new mode of designing different not just in degree from earlier practices, but also in kind. It is an example of the way in which modern "work" is now largely about manipulating data via interfaces (such as the keyboard on which I am writing these words) rather than direct manipulation of physical materials.

Designers also work differently on-screen than they do off-screen. The designers of the Echoviren structure acknowledge this: "To design a 3D printed architecture requires a fundamental rethinking of how we design: there are new details, systems, and processes that open the door to the huge potential of 3D printed architectures."3

Designing in CAD, and the

modes of physical production which it supports, has different affordances to designing without CAD. Just as these digital design tools empower, through their functionality and scope for risk-free experimentation, so they also constrain, and in ways of which the novice designer may be quite

unaware. The digital native who has grown-up with screens and feels quite at home in their bounded landscape may be unable to see beyond the limits of the edges of those screens.4

Just as the driver of a motorcar sees the world framed through a windscreen, and has an essentially cinematic experience of the world through which she passes, so the perceptual plane of the operator of modern design software tools is to some extent defined by the edges of the glowing 2D world in which she works. If the software doesn't allow it, then it can't be done. The danger here is that the designer accepts the software's limitations as absolute, rather than contingent, and does not go on to explore other means of achieving an outcome. In these cases the software may cease to be a tool at our service, and become an arbiter of what we can and cannot create. There is a danger that our imagination becomes screen-bound.

These observations are, however, at odds with the new product promotions of the American consumer electronics and computer brand Apple: "We believe that your content should be the focus of your experience. And everything else should disappear. Even the device itself. . . The most amazing thing about holding it is that you forget you're holding it."5

In the case of a high-tech consumer electronics product such as an iPad, Apple aims to dissolve the divide between its software and hardware in use: "iOS 7 and iPad Air weren't just designed to work well, they were designed to work well together. So the experience of using them together is seamless. Like iPad Air, everything about iOS 7 is simple and incredibly intuitive."6

The new iPad Air is likened to a pencil in its ease of use, versatility, and portability. Just as the pencil disappears to its user when she is in the throes of writing a symphony or devising a mathematical formula, so Apple would have us believe does their device melt away as we become absorbed in the flow of creativity. Rather than imposing screen-bound constraints on the user, this device and its interface apparently "disappear." This is of

course the ideal for any tool—that we forget it is there when using it. Whether this applies to our common experience of using computer design tools is uncertain, yet digital screens are becoming the default surfaces on which we work. The simplest act of note making is likely to be done by tapping into a digital device rather than using pen and paper. Hand sketching can be done direct onto the screen using either our fingertips or a specialist stylus. The virtual documents on which we make our marks closely mimic the appearance of a paper page, with ruled lines and margins, and even mock punched holes. Such details are intended to fool us that we are actually working off-screen, and that the on-screen experience differs only haptically, not visually.

iPad applications aimed at the youngest children, such as Sago Mini Bug Builder (see Figure 2), demonstrate how digital natives are made. Bug Builder is an "educational app . . . geared to children aged 2–4."7 A "letter to parents" from "the developer" sets out the thinking behind it: "Every child loves to make their mark. Sago Mini Bug Builder lets your little artist do just that by customizing their own adorable bug and bringing it to life. Our app is inspired by a classic preschool arts and crafts activity—giving kids a basic shape to transform into something all their own. Walk into almost any preschool and you'll see walls covered in decorated fish, trees or flowers. The activity works because young children have a chance to practice their art skills while always ending up with a recognizable object to show off."8

Bug Builder seeks to translate a traditional physical activity—making artwork with tangible materials—into the virtual domain. The "recognizable object" produced is saved and shared digitally, rather than being put on a wall (unless it is then printed); "'bugshots' can be saved to an internal image gallery to view later. The shots can also be shared with others."9 The persuasive description of the app illustrates the ease with which we can make the transition from messy, physical analogue to clean, virtual digital. In the virtual realm things can also always be "undone," opening

up the prospect of perfectibility, not attainable in the corporeal world; "Sago Mini Bug Builder allows children to create their idea of the perfect insect."10

Whether the pursuit of perfection in creative expression is healthy for youngsters is a perhaps moot point.

Most texts (including this one) are now written on-screen. Most would probably agree that we write differently as a result. The laboriousness of writing by hand means that more effort goes into composing what we write before we commit it to paper. The price of correcting and amending handwritten texts is high. Writing on-screen however, we can be much more slapdash—word-processing software packages afford a different mode of writing based on easy editing and revision of content as we write. We therefore not only write, but also think on-screen. Autocorrect tools such as spell-check hone our text as it emerges from our fingers, as if the computer is our co-author. The danger of course is that the most undeveloped text takes on the appearance of being complete simply because it has the aesthetic on-screen of finished print. In the design process it is better to present prospective users of a product with a prototype which is not over-resolved or "finished" in appearance, in order to get their views on the underlying concept ("What does it do?" "What is it for?"), rather than just surface appearance ("I don't like the colour")—this is the key difference between co-design (designing with people), in which users are meaningfully engaged in the design process, and mere consultation, in which their views are sought on resolved ideas (designing for people).11 Similarly, a neatly formatted text can mislead us into thinking it better than it really is. The world is full of good-looking, bad content which has been all too easily created, digitally.

DIGITAL CONSUMPTION

Just as much of our creation of cultural content is now done via digital screens, using computer-based design tools, much of our consumption of

cultural content also takes place on-screen.

Screen-based visual design, which may be wholly unintended for printing, has been discussed. To this we can add the increasingly widespread digital publishing of books and magazines. New titles are routinely available in multiple formats, digital and non-digital (i.e., paper). A library may purchase a single hard copy of a new book, supplemented with periodic purchase of permissions to download it as a protected electronic file, with enforced printing restrictions and a temporary lifespan. This is a system of distributing texts which gives primacy to digital consumption, in which the value of print is relegated. Libraries, public and academic, are likely to now be renamed as "learning resource centres," with book stacks now only one of their assets. Floor space is increasingly taken up not by shelves but by computer terminals, the technological hardware needed to make these ethereal texts consumable by human eyes.

The iPad app version of the technology magazine Wired is routinely nominated for design awards, such as the London Design Museum's Designs of the Year Interactive Award 2011. The content of the static print edition is augmented with additional animated content, embedded video, and innovations in the navigability within the magazine. Reading a magazine becomes a much more dynamic and immersive experience, with a new gestural language; swiping and tweaking a touch screen is qualitatively different from turning the pages of print. Applications which digitally mimic the action of turning a page are often unconvincing—some gestures from the physical domain are not appropriate for the virtual domain. Rising digital sales of titles such as Wired are accompanied by declining print sales, but rather than the app leaving the print version to languish on the shelves of unvisited newsagents, we are reading these titles across multiple platforms simultaneously: "Conde Nast's Wired magazine averaged digital circulation of 108,622 in the second half [of 2010] . . . including 68,380 print subscribers who activated free digital access, 7,004 digital single copies and 33,237 paid digital subscriptions."12

We may subscribe to the print version but also take-up the option to access the digital edition. One does not necessarily replace the other, especially for a title like Wired which is devoted to the subject of emerging technologies and their impact on culture, economy, and politics. To experience multi-platform editions we of course need the right device(s)—iPad, Kindle, and Nook all represent distinct digital hardware platforms In pursuing the digital, we cannot escape the need for new hardware. Recorded music, even more so than print, is now mostly consumed in digital format, rather than via physical media (vinyl record, cassette, compact disc). For all but the diehard vinyl enthusiast, the visit to the record shop has been superseded by instantaneous download of digital content from a virtual online music store. Audiophiles bemoan the loss in quality necessitated by the compression of recordings for digital transmission, yet for most of us the quality of a file format such as MP3 is good enough given the type of recordings we listen to, and how and where we listen to them (in the car, on the bus, walking down the street). What is certainly lost in the shift to digital music listening is the packaging of the physical medium—the record sleeve (or its impoverished replacement the CD insert booklet), with the commissioned cover artwork, which was a vital part of the cultural experience of consuming recorded music. Digital audio files have no dimension or weight, they require no physical presentation and protection. In designing out the need for these visible manifestations of the recordings' content, we have lost a significant medium of visual culture. We have in this sense rendered recorded music invisible as a cultural product; the promotional video replaces the record sleeve.

IMMATERIAL CULTURE?

We have thus far considered some of the social and environmental aspects of digital production and consumption. The two are of course interconnected—digital products will also be consumed digitally to a large extent. We should now consider this system of digital production

and consumption as a whole.

From an environmental perspective, the broad shift to digital can be viewed positively in terms of an increasing dematerialization of cultural production and consumption. Where once we created and consumed cultural products physically, now we do so digitally, with obvious material savings. In switching to a virtual realm we no longer produce so much physical stuff. Yet this digitalization of cultural content, of the way we both produce and experience cultural products from books to films to music, requires a profusion of screen-based digital devices. The iPod personal music player is quite useless without a life-support network of energy-consuming internet-connected computers. Without a nexus of machines to feed it content, the iPod is just a moulded plastic trinket.

The digital screen certainly delivers dematerialized content; "made from recycled pixels" proclaims the email signature (in green text, of course), assuring us of the environmental credentials of internet-based communications. We are also frequently encouraged not to print email, the implication being that in keeping it on-screen is better for "the environment" (sic) than committing it to paper (see Figure 3). If we do print, the irony is that this colour addition to the email signature actually increases the use of ink, paper, and energy. There are other ways in which we can reduce those impacts: printing duplex (double-sided), non-colour, in reduced type size, using hollowed-out fonts. By lowering the impacts of making printing we erode the case for not printing. Yet is printing actually less preferable than not printing? When making an online hotel reservation we may well select the option: "I want to be eco-friendly and receive my invoice by email." But we too easily forget that the screen on which we read that message is itself a physical technological object, with an essential and significant materiality. The content carried by the screen may seem virtual and without physical dimension, but its means of production, transmission, and consumption are undeniably corporeal. An email cannot exist without a huge supporting infrastructure of networked technological devices. The

airline flight boarding pass which is received and retained in digital form in a handy folder on our smart phone requires that we have our phone to hand and at the ready throughout our journey through airport departures. Many of the chapters in this volume examine the environmental burden of this ecology of mediating equipment, the hardware which allows us to use the software to (seamlessly, for Apple) generate and consume our virtual content. This burden is exacerbated by the fact that our screens are hopelessly caught up in an arms race, in which obsolescence lurks just around the corner for the most cutting-edge technology. The IUCN Red List of Threatened Species has since 1964 provided an inventory of the global conservation status of biological species, to evaluate the extinction risk of thousands of species and subspecies.13

The "red list" of threatened screen species currently includes such technologies as the cathode ray tube (CRT); how long before we add Liquid Crystal Display (LCD), plasma, or Light Emitting Diode (LED)? There are categories of product obsolescence. We discard our once-cherished devices not simply when they are broken or have failed us and are too expensive or difficult to repair (economic obsolescence), but also because we simply tire of them (aesthetic obsolescence), the need for them disappears (social obsolescence), or we are seduced by newer replacements with more-desired features (technological obsolescence).14

The rate at which we replace our digital devices, as with many consumer products, is often driven by perception rather than need. An upgrade from one generation of iPhone to the next is unlikely to be motivated by utilitarian reasons alone. We upgrade our handset because it is the default offer when we come to renew our mobile network contract. There is no encouragement to refuse the upgrade. There is the option to opt for a "better" product, such as the Fairphone (see Figure 4) —"committed to addressing the phone's full lifespan, from use and reuse to recycling."15

Designing with end-of-life in mind is the ecodesign response to minimizing

impacts of product manufacture, without necessarily challenging norms around product lifespan and patterns of use. A more radical approach is designing for longevity, and seeking to extending the product lifespan, for example through modular design. This strategy problematizes not simply the product itself, but the patterns of consumption and early replacement which define its use. Phone Blocs (see Figure 5) proposes a modular handset design in which the different functional elements of a smartphone are kept as separate components, each of which can be independently replaced as needed. This results in “a phone worth keeping” because it can be adapted to individual and perhaps changing user requirements.16 Functional obsolescence and early replacement are therefore designed-out, as long as we value the aesthetic qualities of the device. Phone Blocs aspires to be more transformational and disruptive than Fairphone in that it overtly challenges the structure of the modern mobile phone marketplace.

The proliferation of digital screens is not confined to products of personal consumption. Public spaces from underground rail stations to museums and galleries are becoming increasingly occupied by screens. Decode: Digital Design Sensations was held at the Victoria & Albert Museum, London in 2009–2010: “The exhibition will show the latest developments in digital and interactive design, from small screen-based graphics to large-scale installations.”17

The surfaces of the exhibition space were heavy with equipment; while our interactions with technology at the exhibition were intangible and ephemeral, the stuff we interacted with certainly was not. Interaction required a tangible, physical medium. A visit to Decode also highlighted the common blight of dead screens—this is not a technology you can always trust to reappear when you want it. Information technology is peculiarly fragile and vulnerable to risks and threats which are rarely acknowledged until an organization’s systems crash, activities dependent on those systems cease, and we become paralysed as our essential electronic tools are taken away from us.

It is a moot point as to whether the wholesale migration to digital screens reduces the overall material costs of cultural production and consumption. There is certainly a significant energy cost to our increasing generation and dissemination of digital content. Discussion of competing television screen technologies—LCD, plasma, OLED—often refers to relative energy consumption efficiencies, but these differences seem to have little effect on our buying choices unless translated for us by a showroom salesman into significant differences in anticipated running costs. But if we are motivated to resist the creep of digital screen culture, how might we respond?

Change the View

The most obvious way in which we can personalize our computer screen is to change the background wallpaper image which sits on our screen desktop. Of the default images available from the computer itself, many are heavily treated representations of idealized natural scenes; waterfalls, meadows, and gorges abound. These stylized synthetic images aim for the sublime effect of eighteenth- and nineteenth-century Romantic landscape painting, so that we feel like the Wanderer in Caspar David Friedrich's famous Wanderer above the Sea of Fog (1818), on the verge of misty profundity. This is quite dangerous if our nice background wallpaper image of "nature" reassures us that all is well with the world outside the confines of our digital domain. Escapism is dangerous if it leads us to denial of the actual state of things. An environmentally themed digital wallpaper image would probably qualify as greenwash.18

Turn It Down

Many energy-using products have an "energy saving" mode, in which some functionality is sacrificed with a resulting drop in power consumption, for example by dimming the backlight on a television or computer monitor. The energy savings may be significant, but performance may be severely

compromised.

Blackle.com—the black Google-powered web search page—was created in response to research suggesting that a CRT computer monitor needs more power to display a white screen than a black one. Although this may sound commonsensically true, subsequent discussion suggests that any savings would be either negligible, or non-existent as the world abandons CRT screens.19

A brief experiment with Blackle reveals that you can't really see what's going on when you do try to use it, such is its dimness. But perhaps that is the hidden intention, to get us unhooked from our screens via an act of "critical design"?20

As is so often the case, the well-intended eco-worrier is thwarted in her search for a clear answer on which course of action to take: "the effectiveness of using the 'black web' technique to save energy is a subject of intense debate."21

Which is to say, it may be worthwhile, maybe not.

Go to the Cloud

"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."22

With the advent of the cloud, not only do we not need a desk or office, we no longer need our own computer software or even hardware in order to access our data and work on our files. As a result we certainly feel lighter as the burden of technology is removed from us. Yet as other chapters in this volume examine, this is simply a case of moving the environmental burden elsewhere, as dispersed individual computers are replaced by huge centralized server farms or data centres, consisting of thousands of computers which are always in a state of readiness to respond to our needs. For the individual user this is a case of out of sight, out of mind, but in the

bigger picture nothing has changed for the better. The same argument applies to the electric motor vehicle (EV), which claims to be zero-emission in use, but we must then ask how the electricity it runs on was generated. If this comes from conventional fossil fuel energy generation, then all we have done is shifted the location of the emissions—although we at least get cleaner air in the immediate vicinity of where these vehicles are used, notably our cities.
In relation to cloud computing: "We now have the ability to run our applications on thousands of servers, but previously this wasn't even possible. To say it another way, we can potentially use several years worth of energy in literary [sic] a few hours, where previously this wasn't even an option. So . . . hypothetically we're using more resources, not less."23
Or, more succinctly: "We might end up providing more efficient virtual resources but we will end up consuming vastly more of them."24
This is a classic environmental rebound effect; the potential savings offered by improved technological efficiency are actually offset (and more) by more profligate use. This is the same behavioural pattern as when we don't turn off low energy light bulbs just because they don't use as much energy as what they replaced. Naming centralized computing 'the cloud', with its ethereal connotations, has probably been unhelpful in this regard.

Put It to Sleep

Many energy-using products have a standby or sleep mode. This represents a state of rest in which a trickle of power is used, to ensure that the device is ready to spring into life and full capability when needed. The existence of this mode has aroused much debate in relation to energy consumption—many electrical devices are in effect never turned off, even when they are not needed for extended periods of time. "A typical microwave oven consumes more electricity powering its digital clock than it does heating food. For while heating food requires more than 100 times as much power as running the clock, most microwave ovens stand idle—in 'standby' mode—more than 99% of the time."25

A microwave oven is therefore simply an extremely bulky digital LED clock for the vast majority of its life. The only way to truly stop its consumption of electrical energy is to switch it off at the wall socket. This is fine in the case of relatively simple electrical products such as a microwave oven, but more sophisticated products such as digital televisions may have to go through an extended restart process whenever they are switched on again. In these cases there is a significant disincentive to turn them off, resulting in permanently winking lights and humming devices, constantly reminding us of their steady energy use.

Go Retro

The rapid rate of obsolescence of our technological devices (although reliable data within which to detect any trends is apparently elusive[26]) means that there is always a steady supply of digital screens into the collective waste stream. This can breed nostalgia for once-cherished machines and interfaces. Vintage or retro computer museums such as the Retro Computer Museum in Leicester, England, and the Oldenburg Computer Museum in Germany seek to preserve and display personal and domestic computer and console systems, ideally in full working order. These machines have now been surpassed in terms of functionality, reliability, and portability, yet are considered worth preserving as carriers of cultural memory. Personal computers from the 1970s and 1980s represent the prehistory of contemporary machines, and are barely recognizable as antecedents of the sleek, ergonomic, miniaturized devices with which we are now so comfortable.

Yet their preservation as cultural artefacts demonstrates the extent to which we as users of these machines inhabit their use-world. We feel at home on the screens that we first encountered, their limitations reminding us of a simpler time for us, and also perhaps for society.

While enthusiasm for obsolete screen technologies is likely to be driven by personal nostalgia for times passed, there is often an environmental

argument for retaining functioning devices for as long as they are useful. The manufacture of a product consumes resources; it is therefore sensible to make that product last for as long as is possible in order to get most value from those resources. The exception is products which consume energy or other resources in use. In their case, early replacement by an alternative which is more efficient in use may well be better than carrying on with an old inefficient product until it fails. The precise ideal point at which an old product should be replaced by a new one may be difficult to ascertain, however, as it requires detailed and accurate life-cycle analysis data which is simply not available.27

It intuitively feels right to make our products last as long as possible, even more so if we are motivated by concerns of environmental and social sustainability. The Antiques Are Green campaign (www.antiquesaregreen.org) opportunistically encourages us to avoid buying new furniture on ecological grounds. The most sustainable approach is to not replace the products we already have, with the possible exception of those which consume resources in use—which of course includes all digital screens.

Hack it

Energy- or eco-efficiency only gets us so far, however. Being a little better, a little less bad, in our consumption of resources is not the answer, a point made in Cradle to Cradle, the influential book calling for the redesign of our current inefficient and ineffective material cycles.28

If turning off our devices is the only sure way of temporarily halting their energy use, a more effective (although perhaps Luddite) response would be to dispense with them outright. The present recycling of waste electronic and electrical equipment is a hugely contentious issue, particularly when viewed globally.29 Many of our unwanted devices are simply not recycled in any meaningful sense, despite the good intentions and confident declarations of many of

those involved in the post-use chain of custody. A Google image search reveals no shortage of more domestic reuses of computer housing, as, for example, planters or assorted storage bins. While these might seem slightly frivolous examples of repurposing the least valuable parts of extremely technologically advanced equipment, they at least abide by the waste management hierarchy (reduce, reuse, then recycle) and give products whose broken inner workings will remain mystical to most of us a more immediate utility. The conversion of a defunct CRT monitor housing to a hamster cage (see Figure 6) is a seemingly unwitting satire on the fragility and transience of modern technological products. Online blog responses to this image vary from enthusiastic praise for the creative reuse to scathing criticism of its inappropriate housing conditions.

The contemporary "upcycling" movement encourages all of us to rescue discarded products and materials, and give them a new life through creative reworking, or a cosmetic facelift. Such practices are politicized in terms of both reducing waste and reviving a culture of everyday (re)making:

> Upcycling is a movement with the objective to reclaim authenticity and happiness, while at the same time limiting waste. Upcyclista sees authenticity in the unique objects created by the diverse, imaginative, and courageous minds of the artists.30

While most of this activity is strictly analogue—focusing on furniture, textiles, and decorative craft objects—the emergence of electronic tools such as Arduino and Raspberry Pi takes this making ethos into the digital domain. "Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists and anyone interested in creating interactive objects or environments."31

This is making rather than remaking, and for all the rhetoric of democratization and revolution, technically constrained. Yet it does represent a significant opening-up to non-specialists of producing with electronics. A possible by-product of this phenomenon is the potential for environmental

savings that might come from a reduction in our production of technological devices. If we make only what we need, how and when we need it, then the current proliferation and casual disposal of electronic equipment may be reduced. If a root cause of e-waste is consumer disempowerment in the product lifecycle, then a shift to making and upgrading by empowered "prosumers" (in the sense of a producer-consumer, rather than professional/consumer as a market segment) offers a potential route to addressing this.32

POWER-DOWN

This chapter has explored some of the social and environmental implications of the digital screen as the dominant medium of our immersive high-tech world. The extent to which we find the digital screen empowering or alienating will vary, from person to person, maybe even from one day to the next. We should certainly beware of thinking that screen culture is necessarily our saviour from ecological harm. The answers to our over-abundance of material artefacts and over-exploitation of natural resources, if they're to be found, are as likely to lie in old-tech as they are in the ever-multiplying "iWorld" of digital experiences and interactions. The pixels of our digital screens may be effectively and efficiently recycled, but that may not be enough.

Sherry Turkle has examined the unforeseen or unacknowledged harmful social consequences of our contemporary screen culture, particularly for the digital natives who are growing-up in the digital era having always lived on-screen.33

It is the digital immigrants, who can remember life before screens, who may however find the discussion in this chapter most resonant. It is, after all, very difficult to critique the inherent filters through which you experience and engage with the world—just as the designer who has been forged by CAD will find it difficult to imagine designing without it. The physical feel of things, the way we hold them—their stuff-ness—is an important part of how we consume them and their content. The smell of

a favourite book can take us right back to the past, just as well as a song can. The fustiness of yellowing, aged print and the synthetic tang of a fresh new textbook are both powerful reminders of the physicality of our world. Attempting to artificially recreate direct sensory experiences seems a strange route to travel—could an olfactory reading app ever be as good as the real thing? Personal digital reading devices attempt to mimic the experience of reading from a printed paper page, augmenting this with the added functional capabilities brought by electronics. They promise to match the portability of the paperback with almost infinite text storage capacity. But how many books do we really need to carry around with us? The role of marketing is to convince us of the value of the capabilities of new products by creating hitherto unsuspected needs. Yet these manufactured needs may be quite spurious, and perhaps detrimental. Retreating from the dominance of screen culture, perhaps by reinventing the pre-digital as post-digital ("new-analogue"?) is perhaps the most promising response to the increasing proliferation of screens in our everyday lives. The extent to which we can do this alone is unclear; it is extremely difficult to opt-out of a system which locks us in. Attempts to do so will, however, always be interesting.

The Luddite is an experimental limited-edition magazine combining critique of the creep of digital screen culture into all aspects of contemporary life with traditional print production: "A handcrafted, letterpress-printed, magazine focused on human stories that tend to get glossed over in our digital age."34

The result is an extremely self-conscious attempt to challenge the dominance of digital production and consumption in a unified pro-analogue approach to both content and form. The project has its tensions—it is funded via the online crowdfunding platform kickstarter.com; we do not know if the content was generated without the use of digital screens—but it represents a noteworthy contribution to the debate around the growing ubiquity of digital screens.

A satirical example (see Figure 7) provides a corrective view of the

digital turn in our reading behaviour. Traditional print may on this view be both pre- and post-digital reading technology: “This spells the end of clumsy expensive old-fashioned e-reading devices.” Satire uses humour and wit to make constructive (or destructive) criticism of dominant social or political norms and ideas. It succeeds, and is funny, when it resonates with underlying shared concerns. It was stated above that applications which digitally mimic the action of turning a page are often unconvincing in their attempt to translate physical tactile gestures into the virtual domain. Applying the language of e-readers to the “EyePad” (the traditional print copy of Private Eye magazine) reveals the limitations of the technologies by which we are told it is being rendered obsolete.

The 10,000 Year Clock being built by The Long Now Foundation comes from the same position as the EyePad, but is certainly not satirical. “The Clock is designed to run for ten millennia with minimal maintenance and interruption. The Clock is powered by mechanical energy harvested from sunlight as well as the people that visit it. The primary materials used in the Clock are marine grade 316 stainless steel, titanium and dry running ceramic ball bearings. The entire mechanism will be installed in an underground facility in west Texas.”35

The Clock is conceived, both literally and metaphorically, as a monument to long-term thinking of the kind which saw the construction of medieval cathedrals. Its mechanical design is determined by a need for resilient and autonomous operation, and longevity. As such the Clock presents a counternarrative to the inherent networked complexity of our present digital systems. The challenge for the architects of our digital culture is to emulate the robustness, longevity, and steadiness of the traditional technologies which digital technologies seek to replace, but may in fact be outlived by.

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