Strategic Design Research Journal, 10(1): 12-22 January-April 2017
Unisinos – doi: 10.4013/sdrj.2017.101.02

Spimes and speculative design: Sustainable product futures today

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Abstract
This paper unpacks Sterling's concept of *spimes* and outlines how it can be developed as a lens through which to speculate and reflect upon the future of more preferable and sustainable technological products. The term *spimes* denotes a class of near future, sustainable, manufactured objects, and unlike the disposable products, which permeate our society today, a *spime* would be designed so that it can be managed sustainably throughout its entire lifecycle. This would have the goal of making the implicit consequences of product obsolescence and unsustainable disposal explicit to potential users. With the current rhetoric associated with the so-called *Internet of Things* promoting existing production and consumption models, the time is right to explore Sterling's concept in greater depth. In doing so, this paper examines the meaning of the term *spimes*, distinguishes the concept from today's Internet-connected products and posits design criteria for potential near future *spime* objects. The paper concludes with an initial evaluation of a speculative design fiction created by the author – the *Toaster for Life* – which seeks to embody several of the *spime* design criteria in order to facilitate audiences in considering the unsustainable people-product relationships which define present day behaviour, and also aid the author in reflecting upon the design fiction process itself.

Keywords: spimes, sustainable product design, internet of things, speculative design, design fiction.

Introduction

As populations continue to grow in size and affluence, so too does the consumption of material goods and services. Allied to the linear production model of "take, make and dispose" that defines much of our global manufacturing industry, such profligate consumption has been shown to be highly detrimental to environmental sustainability (Webster, 2015). Electronic products have been shown to be distinctly unsustainable, with electronic product waste (e-waste) now said to be the fastest growing waste stream in the world today, while the material resources needed to manufacture such goods are becoming ever more scarce (Greenpeace, 2014). Product manufacturers' penchant for planned obsolescence drives this culture. By using cheap, subpar materials and purposely failing to incorporate effective means for repair, upgrade and recycling, the lifecycles of most electronic products are designed to be brief. They are further curtailed by routine changes to functionality, aesthetics and software, resulting in older devices becoming quickly outmoded by newer designs (Slade, 2007).

The inherently iterative nature of digital technology also plays an important role in product obsolescence. Since the 1960s, deference to Moore's Law throughout industry and academia has led to continual updates to computer software and hardware. Moreover, both the cost and scale of components such as resistors and semiconductors have significantly reduced, and global wireless networks and infrastructures have become almost ubiquitous. The result is that in recent decades we have seen computational capability spread beyond conventional screened devices to a plethora of other products. Dourish and Bell (2011) note how over the last 25 years, ubiquitous computing and Moore's Law have in many ways consolidated their position as the dominant rhetoric throughout computing research and industry.

Towards preferable futures

Recent years have witnessed a growing interest in a corollary of ubiquitous computing, the so-called *Internet of Things* (IoT). The term is increasingly being used to denote a class of everyday objects whose material elements are augmented by digital capabilities such as embedded software and connectivity through mobile Internet and radio-frequency identification (RFID) (Coulton *et al*., 2014). Seeing opportunities for product innovation and business growth, designers, technologists and manufacturers have been quick to explore the potential of the IoT. The Pebble Watch, iRobot Roomba Vacuum Cleaner, Nazbaztag Rabbit toy and Nest Smart Thermostat (Figure 1) are cited as some of the first IoT products to find mainstream popularity amongst consumers (Rose, 2014).

Whether or not one subscribes to the hyperbole, the possible futures that the IoT may bring stirs the imaginations of many. The UK government's recently commissioned *Blackett Review* (Government Office for Science, 2014, p. 5) for example, eulogises the IoT as "a transformative development [with] the potential to have a greater im-

Figure 1. Examples of Internet of Things products. Clockwise top left to bottom left – the Pebble Watch (2013), iRobot Roomba Vacuum Cleaner (2002), Nazbaztag Rabbit toy (2006) and Nest Smart Thermostat (2011).

pact on society than the first digital revolution". The report does, however, also make this germane observation about technological change:

> *As with any new technology, there is the potential for significant challenges too… everyone involved in the Internet of Things should be constantly scanning the horizon to anticipate and prevent, rather than deal with unforeseen consequences in retrospect (Government Office for Science, 2014, p. 6).*

Though the report is primarily considering this in relation to the impacts upon privacy and surveillance, this reflection is also highly pertinent to the relationship between Internet-connected products and environmental sustainability. The techno-social hegemony of the Internet initially led some to envision a "dematerialisation" of many physical products, in other words, a paradigm shift from the production and consumption of material artifacts to predominately digital online services. This shift would profoundly benefit sustainability as material resources, energy, and impacts of distribution, consumption and disposal would be radically reduced (Thackara, 2005). Although this projected future is still possible, there is recent evidence to challenge this thinking. The success of Apple's iPhone 6 is one such example – sales of 74.5 million handsets in three months resulted in the biggest quarterly profit ever made by a public company (BBC News, 2015) – and highlights the continued desirability for physical objects. Further, the continued fervour surrounding the IoT suggests that products with material and digital interdependency will persist for the *near future*.

In light of this continued materialism how do we begin to *anticipate* and *prevent* the same unsustainable practices from characterising succeeding generations of products? With spimes, Sterling (2005) put forward a provocative manifesto for changing the relationship between people and material things. In a spime-based future, the key rationale for making connections between material objects and the digital world is sustainability. With the IoT perpetuating existing, damaging production and consumption models, the time is right to explore Sterling's concept in greater depth. This paper considers whether we can develop spimes as a lens through which to reflect upon more sustainable technological product futures, whilst also critiquing the unsustainable people-product relationships that define today.

Spimes – A definition

The term *spimes* was coined in 2004 by the futurist Bruce Sterling to denote a class of near future, sustainable, manufactured objects. Sterling (2005, p. 11) envisions spimes as "material instantiations of an immaterial system… they are designed on screens, fabricated by digital means and precisely tracked through space and time throughout their earthly sojourn". "Spime" is the contraction of the words "space" and "time". Unlike the manufactured products that permeate our society today, a spime object would be an ongoing means rather than an *end*. Crucially, a "spime is a set of relationships first and always, and an object now and then" (Sterling, 2005, p. 77). In a spime-based future, material products, objects and things are materialised *nodes*, physical anchors to an expansive, networked digital domain. As Taylor and Harrison (2008, p. 345) note, "the importance of a spime is not so much the physical material object. It is the provenance, history and support system that it creates".

To help illustrate his concept, Sterling describes how a bottle of wine would manifest in a world where spimes are commonplace. In order to unpack the term, an adapted form of his exemplar is presented here:

> *Stage 1*. You first encounter the spime bottle of wine as a digital image while searching on a website. The image is deep-linked to the genuine, three-dimensional computer-designed specifications of the object including engineering tolerances and material data as well as its drinkable ingredients. At this time, the spime bottle of wine has no material existence beyond this "digital instantiation".

Stage 2. You purchase one bottle. The transaction results in the manufacture of its physical, "material instantiation". Details of your purchase are automatically integrated into your personal *spime management inventory system*. This enables you to manage your spime throughout its lifespan giving you access to information such as your bottle's unique ID code and its history of manufacture plus a variety of material and energy flow data.
Stage 3. Your bottle is delivered to your address. It is location-aware, environment sensing, self-documenting and geographically trackable – a material object that is "information rich" and which continually stores and transmits digital data about its environment and its lifecycle.
Stage 4. You finish the bottle. This iteration of your spime has now reached the end of its useful, material life. When you dispose of the bottle, it is deactivated, disassembled and, being made from recyclable substances, is folded back into the manufacturing stream for future spimes. The data it generated during its lifespan is saved and remains available online for historical analysis by you and any other interested parties (Sterling, 2005).

The spimes concept is central to Sterling's book *Shaping Things* (2005) in which he contends that the practices inherent to industrial product design and technological evolution cannot continue in their current form because of their lamentable impacts on environmental sustainability. He asserts that modern societies are using energy and materials which are finite, toxic, lead to climate change, social inequity and "cause resource wars. They have no future" (Sterling, 2005, p. 7). To make his case, Sterling traces the evolution of what he calls our "techno-culture" – the relationship between people and their tools – throughout the previous 2 million years. His analysis moves from *artifacts* (farmers' tools) to *machines* (customers' devices) to *products* (customers' purchases) to *gizmos* (end-users' platforms) to beyond, to what he considers a preferable future, a future defined by *spimes* (Figure 2). Importantly, Sterling argues that a succeeding techno-culture does not abolish any of their predecessors outright, but merely – to use his ecologically centred phrase – *compost them*, stressing that "the future composts the past". A transition to a spime-based techno-culture would not replace the artifacts, machines, products and gizmos that we have today but would alter the forms products take and most significantly, change the relationships people have with them.

Helpful in illustrating the near future world in which spimes exist, the exemplar also serves to highlight how a spime product would always have a lineage to previously dominant techno-cultures. A spime bottle of wine is, afterall, still a bottle of wine and similar to those drunk for millennia. *It is the informational support afforded by a spime that changes the relationship between people and the object and not the object per se*. Sterling asserts that techno-cultures prior to gizmos had simpler, more linear sets of relationships. People were closer – in terms of both of their understanding and locale – to the industrial processes that were involved in manufacturing their material goods. This transparency he contends, became extremely muddied in the transition to gizmos due to an overreliance on increasingly complex material extraction, manufacturing, supply chain and consumption infrastructures.

Sterling argues that the informational support granted by spimes would make implicit industrial, distribution and consumption processes once again *explicit* – visible, obvious, and potentially, more sustainable. This sits in stark contrast to our present behaviour where a bottle of wine would arrive in one's…

> *possession seemingly stripped of consequences, but those consequences exist [and] the mythic moment… of throwing it "away", is supposed to be the sudden and total end of [your] mutual narrative as human and object. But that is by no means any end of any object (Sterling, 2005, p. 74).*

In a spime techno-culture, one would know where the bottle of wine has come from, where it is and where it will go. Sterling posits that this transparency would alter the way new products are designed and how people will ultimately use and value them.

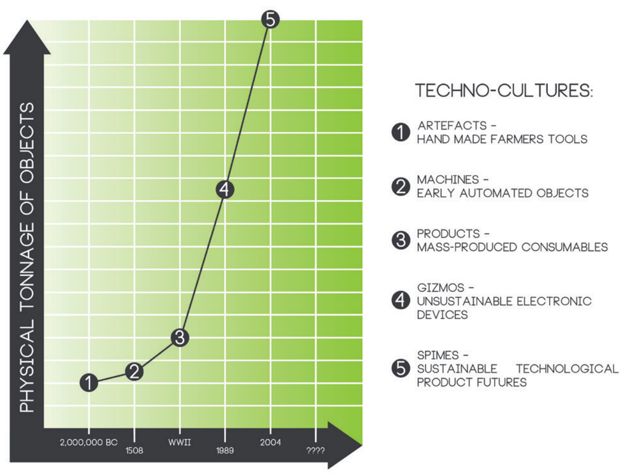

Figure 2. Sterling argues that the relationship between people and their tools has evolved through five distinct "techno-cultures" with the shift to spimes beginning as early as 2004 (image after Sterling, 2005).

Spimes and the known present

It might be argued that in the decade since *Shaping Things* was published, spimes have in fact, come into existence. *Stages 1* and *2* of the exemplar certainly share similarities with our *known present*. Today, you can search through millions of digital product images on Internet commerce sites such as Amazon. Purchase a particular product and details of the transaction are automatically added to your personal account. You are then able to track the delivery journey of your product's material incarnation – from when it is packaged to when it arrives at your personal address.

Stage 3 also resembles the contemporary trend for "smart" or "intelligent" objects. Such products incorporate technologies like wireless Internet, RFID and global-positioning (GPS) capabilities. Able to monitor their environment and display feedback data, most "smart" products are proprietary, that is, they are designed and manufactured by centralised, corporate brands. The past decade has, however, also witnessed the growth of decentralised technological practices like the Maker Movement, Fab labs and open hardware and software development. Within these sub-cultures, people use the aforementioned technologies in conjunction with other tools like CAD software and 3D printers to design and build bespoke connected objects.

It is clear then, that while writing *Shaping Things*, Sterling was heavily influenced by many of the nascent technologies and practices that are outlined above. He was also prescient in projecting how they might be employed. I argue, however, that *Stage 4* of his exemplar has yet to come to fruition, and thus it is this stage we will discuss in the next section as the attribute that separates a spime object from an IoT product.

Figure 3. A prototype developed by the BBC and design firm Schulze & Webb, the "Olinda Radio" is often described as a "spime" merely for the fact that the device is connected to the Internet. Crucially, unlike a spime, however, Olinda has not been designed with sustainability in mind.

Spimes are not things

The term the *Internet of Things* was coined by Gershenfeld *et al.* in 2004, the same year Sterling originated spimes. Like spimes, many of the technologies and practices discussed in the previous section have become synonymous with the IoT. It is unsurprising then that both terms often get used interchangeably to denote an Internet-connected material object. This misappropriation of "spime" is predominately found within commercial design practice with projects such as that depicted in Figure 3 – the "Olinda Radio" (Ferne, 2008). While this project was technically innovative, it was an exercise in "connecting the material to the digital" and little consideration was given to the sustainable narratives a spime-based future might bring.

In academia, the spime concept has mostly been discussed in a purely theoretical manner and only contextualised within technological fields like ubiquitous computing, human-computer interaction, interaction design and the IoT (Thomas, 2006; Greenhill and Fletcher, 2009; Saffer, 2010). One academic project that does examine some of the sustainable implications of Sterling's concept is Bonanni *et al.*'s "Spime Builder" (2009). The authors produced a prototype for a Tangible User Interface, an immersive design tool which merges physical and digital design processes into a single practice. This is in "preparation for a future where connectedness will become central to the value of most physical products" (Bonanni *et al.*, 2009, p. 264). They planned to introduce product Life Cycle Assessment capabilities into the next iteration of the prototype to allow designers to more easily incorporate sustainable material, manufacturing and disposal strategies into their connected product designs.

Sterling determines that a spime-based techno-culture came into effect from 2004 – a year prior to the release of *Shaping Things*. He does this in order to affirm the notion of product lineage across techno-cultures. The origins of spimes – both pragmatically and ideologically – are in the *present*. Spimes *will* develop out of gizmo techno-culture and having done so, will share some characteristics with gizmo products such as the aforementioned technologies and practices. However, the informational support spimes could offer would be very different to those of gizmos, especially in regard to sustainability. Spimes should therefore also be seen as an ideological rebuttal to the unsustainable practices that are intrinsic to gizmo techno-culture.

Thus, I argue that although spimes might share some common attributes with today's IoT products and services, the latter is still strongly representative of gizmo techno-culture. The design, informational support and "material instantiation" of IoT products are yet to become distinctly spime-like. For, although more and more of today's material things are being given digital capabilities, they will soon be replaced by newer alternatives and eventually discarded. Consequently, today's connected things will enter the electronic product waste stream with their precious materials and embodied energy forever lost. In contrast, spimes, by their very nature, would be an ongoing means rather than an end. I would go as far as to describe the *present* as a "transitionary period" from the IoT to spimes but we are yet to definitively begin designing, manufacturing and consuming the latter.

Seven classifying design criteria

To further distinguish spimes from today's IoT products and reclaim the term from continued misappropriation, I present *seven classifying design criteria for spimes*:

Context

Several neologistic terms with similar definitions to that of the IoT are used to denote material objects that connect to the digital world. These include "hyperlinked objects" (Bonanni *et al*., 2009), "enchanted objects" (Rose, 2014) and perhaps most prominently "smart objects" (Porter and Heppelmann, 2014). Kuniavsky (2010) also appropriates the "smart" modifier, coining the term "smart things" to describe Internet-connected material objects that have what he calls "information shadows". I assert that the term spime sits apart from these descriptors with the key difference being the reciprocal relationship between a spime's material instantiation and digital instantiation. For example, whereas Kuniavsky separates the material and digital into two separate "entities", Sterling (2005) does not. Depending on context, I contend that "spime" can be used to refer to both the *archetype* object – the original digital instantiation as created by the designer – and a user-specific iteration of the same object – the material instantiation with which a person physically interacts.

Technology

The earliest, near future instantiations of spimes would likely be characterised by a convergence of the following six technologies and practices (adapted from Sterling, 2005 and Maly, 2012):

(i) RFID tags – Small, inexpensive means of remotely and uniquely identifying a spime object over short ranges.
(ii) GPS – A mechanism to precisely locate a spime object on Earth.
(iii) Internet Search Engine – Search functionality affording a front end to mine the enormous amounts of data that a spime object constantly collects and transmits.
(iv) CAD Software – Tools to digitally construct and manipulate endless iterations of a spime object.
(v) 3D Printers – Sophisticated, automated and robust means to rapidly fabricate a "digital instantiation" of a spime object into a "material instantiation".
(vi) Eco-materials – Materials which are ecologically safe and durable but also highly versatile. When a spime object is no longer required, they can be cheaply returned into the production process as a raw material for future spime objects.

Sustainability

Many contemporary products are designed, manufactured and/or function as a result of either, or a combination of the previously listed technologies/practices. It could be argued then that products such as a "smart phone" can be described as a *proto-spime*. The object possesses functionality which allows it to be location aware (through GPS), networked (through wireless mobile Internet), environment sensing (through embedded sensors/actuators) and provide search functionality (through an Internet search engine) amongst other attributes. Likewise, with its ability to sense, track and display a household's energy consumption, some might also view the Nest Smart Thermostat as a *proto-spime*. Indeed, Nest's product is commonly seen as a more sustainable alternative to conventional domestic energy monitoring, as people who use it can ostensibly manage their energy consumption via their smart phone or tablet.

Proto-spime does appear to be a logical descriptor for such products, given that we may be, as posited earlier, in the midst of a "transitionary period" between gizmo and spime techno-cultures. However, in wanting to make an explicit distinction, I argue that products such as smart phones, tablets, and those characteristic of the IoT like wearable fitness trackers and energy monitors, *cannot* be classified as spimes. They do not embody *Stage 4* of the exemplar, that is, they have not been designed to ensure that their entire existence can be managed *sustainably* – from initial design to rebirth as a future object *ad infinitum*.

In expanding the theory of ubiquitous computing, Weiser and Brown (1995) envisioned a future world where widely dispersed computation is "calm" or "ambient". I argue that IoT products such as the Nest Thermostat more closely resemble Weiser's and Brown's vision than Sterling's spimes. Nest's device may encourage people to reflect upon, and subsequently modify, how and when they consume household energy. Despite this, it is only "when the metrics count for more than the object they measure [that] gizmos become spimes" (Sterling, 2005, p. 23). Like most IoT products, the informational support afforded by the Nest Thermostat centres on the "use phase" of the product lifecycle and fails to communicate other crucial sustainable information regards the design, production, distribution, maintenance and disposal of the product. IoT products like Nest remain largely "unseen" and preserve the distance between people and the impacts of their products. The inherent unsustainability of today's IoT is designed to be *out of sight* and *out of mind*. In contrast, spimes would have the potential to cultivate stronger people-product relationships, relationships that go "beyond the object" and make product impacts more visible, tangible and sustainable.

Temporality

In stating that spimes "have the capacity to change the human relationship to time", Sterling is raising two important points:

(i) The notion that societies tend to live in the present and fail to consider their collective future. He cites our profligate materialism and its detrimental effect on the planet's ecosystem as the prime example of our lack of foresight.
(ii) It is our tools, rather than our philosophies, that have caused "the most radical changes in our temporal outlook, [that is], tools of temporal perception, [for example] clocks, telescopes, radio-carbon daters, spectrometers" (Sterling, 2005, p. 50).

For Sterling, spimes would be the next significant *tool of temporal perception*. On a macro level, a spime-based techno-culture's innate transparency and material sustainability would change people's outlook, shifting society to a preferable future beyond the unsustainable practices that blight our present. On a micro level, spimes would transform the temporal nature of the relationship that people have with their products. This shift would, however, come about in a way that sits contrary to conventional sustainable design discourse. Established theory advocates the need to slow the pace of change, thereby extending the use phase of products and technologies which, in turn, reduces obsolescence and waste. Conversely, though spime objects would afford stronger, more transparent people-product relationships, these relationships would be built on *faster technological product lifecycles*. In a spime techno-culture, product obsolescence is actively embraced. Spimes can only come to be, if the products "getting manufactured [are] as easy to dispose of as [they are] to make" (Maly, 2012, para. 22). Thus, spimes are not only *ideologically of the future* – a manifesto for moving beyond the unsustainable production and consumption models of today – but also *pragmatically of the future* – as the physical, infinitely recyclable eco-materials required for their sustainable existence are yet to exist.

Sterling's decision to frame obsolescence as a positive attribute of spimes stems from his critique of 20th century design, particularly *functionalism*; the modernist credo which originated at the *Bauhaus* design school in 1920s Germany. Dieter Rams, the Chief Design Officer at Braun consumer products for over 30 years, is a prominent advocate of such thinking. Rams has argued for a type of "good design" to combat planned obsolescence and ensure that mass-produced electronic products remain "timeless" – functionally, aesthetically and emotionally relevant for many generations (Lovell, 2011). Rams began to develop his *Ten Principles of Good Design* in the mid-1970s, two of which specifically focus on product sustainability – "*Principle 7. Good design is long-lasting*" and "*Principle 9. Good design is environmentally friendly*" (Rams, *in* Klemp and Ueki-Polet, 2010).

Rams' ethos continues to be celebrated throughout industrial product design practice today, not least by Jonathan Ive (*in Objectified*, 2009), Chief Design Officer at Apple Inc and designer of the Apple Watch, iPod and iPhone. Figure 4 depicts functionalist products designed by Rams and Ive. Sterling (*in* Maly, 2012) is more circumspect, describing Rams' ethos as "timeless design for very time-limited objects". In line with Sterling, I argue that whilst Rams put forward his principles in earnest, his strategy has unfortunately failed. Our present technological product culture is built upon capital logic which allows unsustainable modes of design, commerce and consumption to flourish. Irrespective of whether they might be considered "good" or "bad" design, today's products will eventually become obsolete in the wake of changes to markets, fashion, materials and technologies. Furthermore, peoples' individual and collective needs, desires and values significantly alter over time – a product that is "good" today, may not be "good" tomorrow.

Concluding that established thinking such as Rams' is undermined by *time*, Sterling proposes that we should instead begin to design products with protean lifecycles. A spime-based techno-culture would afford people latitude to dispose of their material objects quickly, and/or, cultivate longer-lasting relationships through product care and maintenance. As I see it, eco-materials would enable spimes' material instantiations to be enhanceable, customizable, repairable and recyclable. Rather than forever remaining the same like Rams's "good design", spimes would have the innate ability to transform and reflect changes in technology, cultural trends and peoples' needs.

Figure 4. Examples of "good" or "bad" design? Top left and top right – the Braun SK 4 Radio-Audio Combination (1956) and FS 80 TV (1964) designed by Dieter Rams. Bottom left and bottom right – the Apple iPod music player (2001) and iMac desktop computer (2007) designed by Jonathan Ive.

Metahistory

As illustrated by *Stage 2* and *3* of the bottle of wine exemplar, a spime object would generate data throughout its entire lifecycle. But, in addition to a spime's present, is there also "value" to be found in a spime's past? As *Stage 4* of the exemplar states, all spime data "is saved and remains available online for historical analysis by you and any other interested parties". It is at this point that we should return to the idea that the informational support a spime product offers is more significant than its material form. Although I have argued that spimes are yet to come into existence, I would also contend that we, in today's gizmo techno-culture, interact with products in ways analogous to a world of spimes. For as Csikzentmihalyi and Rochberg-Halton (1981) have shown, we have relationships with each and every material thing that we own. For example, you may still have the copy of your favourite book that you first read as a teenager or may be continually perplexed by the television remote control that you have never quite fathomed how to use. Whatever the personal history between you and your things, this history is presently only recorded in a physical manner on the objects themselves as *patina* – signs of age and use – and as thoughts and memories to which, by and large, only you yourself are privy.

Sterling sees spimes deepening the relationships we have with our material products by *recording* the histories of these relationships and making them *accessible* and *searchable*. This would lead us to a future where silos of people-product histories are *data mineable*, becoming "informational resources [which are] manipulable in real time" (Sterling, 2005, p. 45). In other words, in a world of spimes, our product *metahistories* will become a valuable commodity. With this notion, Sterling is again projecting how present day practices may shape aspects of a spime-based near future. Over the last 15 or so years, the increasing pervasiveness of the Internet coupled with growth in use of data sensing mobile devices such as smart phones and tablets, has led to a thriving *information economy*. Further, *big data* – a broad term for large and complex data sets generated by a multitude of networked nodes – has become a key source of revenue. *Data mining* is the practice of identifying trends and patterns within the data which may consequently be valuable (Attewell and Monaghan, 2015).

Today, Internet-based services like Google Search and Facebook capture and mine our personal data, building customer profiles and selling our information onto other commercial entities such as advertisers. While perhaps inspired by the possibilities of big data, it is more likely that the *open data movement* had a stronger influence on Sterling. Unlike big data, open data sets are made *freely* accessible, as the emphasis is not placed on profit making. Rather, such data is shared and mined to help inform decision-making (Kitchin, 2014). For example, mining governmental open data may lead to changes to public policy or legislation.

Sterling argues that mining our spime metahistories would help inform sustainable decision-making, particularly in relation to the lifecycle of material goods. He asserts that in a spime techno-culture with protean product lifecycles, we would have the ability to make "a great many small mistakes fast [and] it's not necessary that every experience be sensible, logical or even sane – but it's vitally important to register, catalog and data mine the errors" (Sterling, 2005, p. 47). Thus, if we were able to identify patterns of unsustainability within vast amounts of spime metahistories, we may be able to know in advance which design decisions were environmentally damaging and in turn, limit the probability of developing harmful products any further.

Synchronicity

Sterling (2005, p. 42) suggests that we must "combine the computational power of an information society with the stark interventionist need for a sustainable society. The first one is happening anyway; the other one has to happen". The ensuing synthesis would lead to what he terms a *synchronic society*. Different to the centralised, proprietary infrastructures that dominate today's gizmo techno-culture, this paradigm would be built on more open and distributed types of design-innovation practices. Here, Sterling is beginning to envision how decentralised practices like the Maker Movement, "hacking" and Fab labs might significantly shape industrial product design activities in the near future. As has been outlined, in the decade since *Shaping Things* was published, there has been a distinct growth in the number of people engaging in such practices. However, I maintain that they still cannot be considered "mainstream" approaches to the design, production and disposal of products. They remain niche activities conducted in the shadows of mass manufacturing and consumption. Nevertheless, this does not diminish their potential with regard sustainability, and it is no doubt this potential that Sterling wished to imbue in his concept of spimes.

How then would decentralised design-innovation practices lay the foundations for a spime-driven *synchronic society*? The route from design to market for most of today's products is protracted and expensive. As a result, firms strive to retain the intellectual property rights for their product designs which restrict other companies from developing similar devices. Recent years have, however, also seen an increase in firms collaborating with external sources such as academic institutions, technologists and customer groups in order to draw upon a wider body of knowledge and expertise. While proprietorship is still key, it is argued that this *open innovation* model (Chesbrough, 2003) enables firms to remain at the bleeding edge and continue to produce innovative products. I contend that although such activities may engage a broader demographic in product design-innovation processes, for the most part open innovation simply reinforces our present models of production and consumption. The emphasis remains on corporate profitability and not environmental sustainability.

In my view, Rodgers' *diffusion of innovations* (1962) theory provides a more effective model for Sterling's synchronic society. Put simply, *diffusion* is the process by which an innovative idea or technology is communicated through various channels over time among the participants in a social system. Rodgers separates those who adopt new innovations into five main categories: *innovators*, *early adopters*, *early majority*, *late majority* and *laggards* (Figure 5). He stresses that in order to become self-sustaining, an innovation must be widely adopted and to do so, it will rely on *social capital* – a "resource" which "actors derive from specific social structures and then use to pursue their interests; it is created by changes in the relationship among actors" (Baker, 1990, p. 619). I assert that today's decentralised design-innovation practices remain the preserve of *innovators* and *early adopters* and a broader diffusion of spime orientated design activities would be heavily contingent on collective creativity and skills (social capital), the Internet (communication channel) and the future (time).

This interpretation of diffusion also enables similarities to be drawn between spimes and *memes*. Dawkins (1976) coined the term *meme* to explain the spread of cultural phenomena such as speech, rituals, fashion and technologies. In doing so, he was making an analogy with the way in which human genes virally self-replicate, imitate and compete according to Darwinian selection. In more recent years, his term has been re-appropriated to denote when an idea has "gone viral", that is, it is replicated and widely distributed online. The key difference between Dawkins' definition of memes and "Internet memes" is that the former are always accurately assimilated as they diffuse. Internet memes, on the other hand, are deliberately changed by human creativity during diffusion. With their innate informational transparency, malleability and ability to be mined, I argue that the same might well be said of Sterling's spimes and their associated design practices. In the future, a spime could easily "go viral".

Wrangling

In having to negotiate new materials and a new ideology for sustainable design, the transition to spimes would be both a major opportunity and a challenge for tomorrow's designers. In addition to this shift in *how* to design, there would also likely be a shift in *who* designs. As Sterling (2005, p. 22) stresses, "in a spime world, designers must design, not just for objects or for people, but for the techno-social interactions that unite people and objects". Here, he is no doubt making a reference to *Interaction Design*, the field that bridges the disciplines of industrial product design and *Human Computer Interaction*, and which has gained increasing significance in today's era of digitally augmented material products. But are the creators of spimes likely to be interaction designers or product designers or something different?

Spimes, as detailed above, would be a set of relationships first and foremost and a physical object some of the time. Sterling argues that by shifting peoples' sense of value from materials to information, material scarcity might begin to be redressed and people – both individually and collectively – will have a deeper affinity with *their* information. He points out however, that such a paradigm would result in the scarcity of a different asset – *time*. The innate informational transparency of spime objects would grant their users access to vast quantities of data. Resultantly, Sterling asks whether people would give more of their precious time to sift through sustainable product data ad hoc. He concludes that it is critical that spimes, and the relationships that they afford, be designed with fluidity and efficiency firmly in mind. He describes this new focus as *designing for opportunity costs and cognitive load* and terms those who would design said relationships as *spime wranglers*.

I posit that more open, distributed design-innovation practices would also broaden the types of people who would engage in wrangling. Unlike today, in a synchronic society, the acts of creation and consumption would no longer be mutually exclusive. With design expertise and tools more widely dispersed, wrangling would not only be limited to established practitioners such as interaction designers or product designers. Multitudes of people would be consuming the products that they themselves have had a hand in creating. From this perspective, the concept of wrangling shares similarities with both Toffler's notion of *prosumers* (1980) and Von Hippel's *lead users* (2005).

A lens for speculation and reflection

Hales (2013, p. 6) describes the concept of spimes as "rhetorically futuristic… a category of imaginary object that is also an intervention in the present and [which] are "forward looking" akin to the actually futuristic objects they

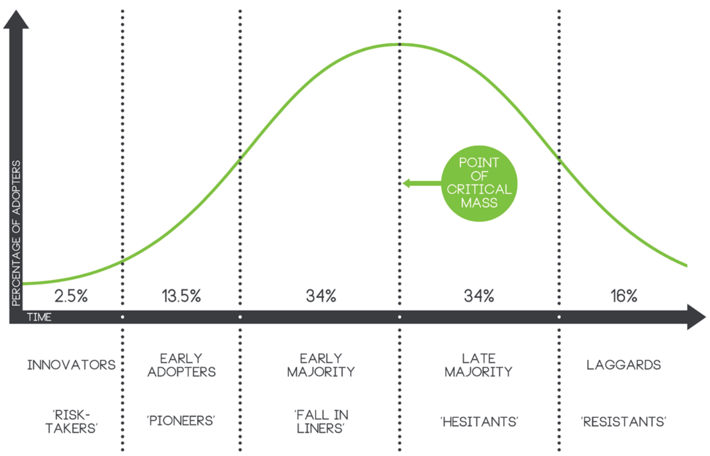

Figure 5. Rodgers determined that new innovations "diffuse" via five different types of adopters and reach "critical mass" between early majority and late majority user groups (image after Rodgers, 1962).

create". If we consider Sterling's text (2005) as the theoretical foundation for the "rhetorically futuristic" construction of spimes, I contend that the emergent speculative design methodology *design fiction* is the most appropriate method for envisioning "actually futuristic" spime objects. Like the term spimes, Sterling (2005) also originated the term *design fiction* and he has since defined the method as "the deliberate use of diegetic prototypes to suspend disbelief about change" (*in* Bosch, 2012, para. 3). Here he is appropriating Kirby's (2010) term "diegetic prototyping" which denotes how a futuristic object or product might be rendered "material" and fully functional in "diegesis", in other words, as a "prop" embedded in a fictional narrative environment or "storyworld". As Tanenbaum (2011, para. 5) states, the use of a fictional frame is central to the method as it enables designers to "make an argument about a potential future by demonstrating that future in a context that a large public audience can understand". In essence, design fictions seek to create a discursive space where the design proposal challenges peoples' perceptions by subverting the "insular, habituated forms, experiences, rituals and expectations" of normative commercial, centralised design practice (Bleecker, 2009).

By presenting a near future spime object as "actually futuristic" within a fictional world, I argue that designers can help audiences to begin to consider the potential implications, meanings and values that spimes may bring and also question whether such a future would be a more *preferable* and sustainable alternative to our present day methods of production and consumption. The conception of a design fiction is also an inherently reflective creative process, as Sterling (n.d., para. 4) is keen to stress, stating that "the best way to understand the many difficulties of design fiction is to attempt to create one". Accordingly, I maintain that the spimes concept can be used as a lens for speculation and reflection, both for the designers that seek to envision them and the audiences that said designers seek their work to engage with.

Figure 6. The front cover for the fictional Toaster for Life product brochure.

Figure 6 and Figure 7 depict the front cover and internal pages of a "product launch brochure" for a spime-based design fiction created by the author – the *Toaster for Life*. I have sought to frame the design as an example of an early "material instantiation" of a spime, one which, as Figure 8 shows, seeks to embody several of the classifying criteria outlined above. By incorporating a convergence of spime-like technologies and practices into the speculation, the toaster's design begins to exhibit a series of potentially sustainable attributes, namely it appears to afford effective *repair*, *upgrade, customisation, recycling* and it is *trackable*. Self-repair is shown to be easier due to the toaster's modular design while upgrades would be possible as the product operates via next generation open hardware and software. Both of these attributes are references to present day design practices. Sustainable product design techniques *Design-For-Disassembly* (Chiodo, 2005) and *modularisation* as well as open source technologies are seen as tenets of decentralised design practices like the Maker Movement (Torrone, 2006). However, these types of techniques are yet to be adopted into the design of most mass-produced proprietary consumer electronic appliances, despite strong calls to do so from organisations such as Greenpeace (2014).

The *Toaster for Life* is also presented as being primarily manufactured from infinitely recyclable materials. Within the speculation, CAD and domestic fabrication have become mainstream activities with aluminium and heat resistant bio-plastics depicted as readily 3D printable. The narrative suggests that this would give people the freedom to customise their material goods as and when they please. The proposal also frames the product as inherently trackable due to most of its parts being fitted with nano RFID tags; a smaller but more powerful iteration of today's radio frequency technology. Users would be able to track the whereabouts of individual componetry throughout the product's entire lifecycle.

In essence, the speculation extrapolates a range of present day technologies and behaviours and marries them with fictitious possibilities. It is this near future con-

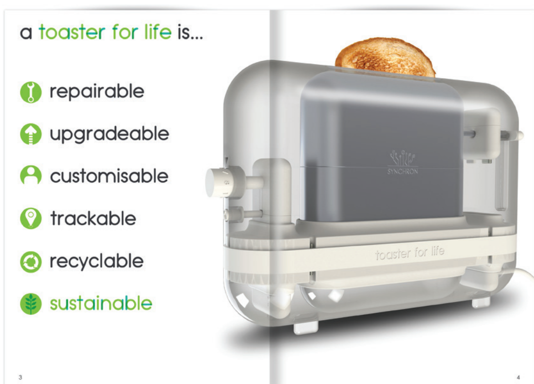

Figure 7. Internal pages of the fictional product brochure.

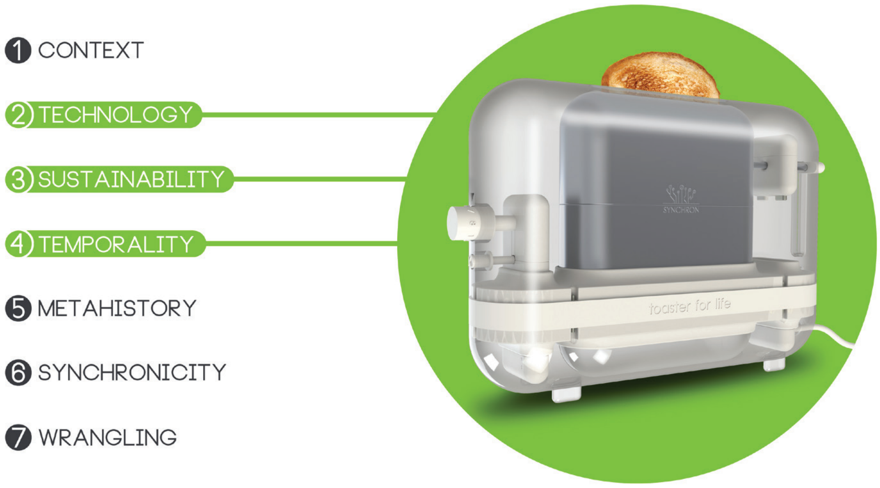

Figure 8. Conceived as an early, near future spime, the Toaster for Life design seeks to embody three of the outlined classifying design criteria for a spime object.

vergence that would lead to new types of sustainable spime-like practices and interactions. Thus, rather than attempting to design a radical new type of "spime product", I have chosen to embody the spime concept within an object which a broad audience could readily identify. Resultantly, I hope that the unfamiliar interactions afforded by a *spime toaster* appear "everyday" and, most importantly, plausible. This plausibility lessens the potential for the product's features and technologies to appear fantastical, unreal or "too futured". Further, the framing of spimes in relation to banal and ubiquitous physical objects also facilitates critique of the unsustainability of the IoT. In a time of both increasing material scarcity and e-waste, we often take objects like toasters for granted. How long will it be before we replace our current products with equivalent IoT style devices and what will this mean for sustainability?

Future work

With this paper I have sought to distinguish spimes from today's IoT products and provide theoretical support for the creation of spime-based design fictions. The *Toaster for Life* speculation is an initial attempt to "apply" aspects of this theory. It is hoped such research might add to discussions regarding the design of connected objects and the implications for environmental sustainability. Going forward, additional reflections on the process of crafting the *Toaster for Life* speculation would be valuable, particularly with regard to the relationship between design praxis and theory, *research through design* methodology and sustainable design strategies. The discursive nature of the speculation also warrants further consideration. If the intention is for design fictions to speak to audiences beyond academia, how does one ensure speculative proposals engage with wider publics?

With the *Toaster for Life* design seeking to embody the earliest material instantiation of a spime object, the speculation does not explore all aspects of the classifying design criteria. This presents opportunities for designers to create further design fictions which reflect upon other attributes of spimes outlined in this paper, for example, how might people interact with a spime's digital instantiation? How would spime metahistories be accessed? How will a spime manifest as a meme? It must also be said, that as a corrective to the IoT, spimes have been framed here in a wholly positive light. The spimes concept does, however, present a number of implications that Sterling's text fails to adequately address and that are beyond the scope of this paper. In my view, this should prompt further interrogation of the spime concept and may again offer designers new possibilities for speculation. One might start by considering how, in addition to hardware, might a spime be designed to also sustainably accommodate software updates. Where would spime generated data be stored and for how long? What are the wider environmental impacts of spime server centres and data distribution infrastructures? How might spimes be framed in relation to the negative rhetoric presently associated with the IoT such as privacy, surveillance and the autonomy of connected products? What happens when spimes go bad?

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Submitted on July 04, 2016
Accepted on February 01, 2017