

Spimes Not Things: Creating A Design Manifesto for A Sustainable Internet of Things

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Abstract: The rhetoric that surrounds the Internet of Things (IoT) contends it will bring about utopian transformative change throughout society, particularly in regards to sustainability. Little discourse however, recognises the intrinsically unsustainable nature of IoT devices themselves. Under a façade of innovation, the IoT is a breeding ground for superfluous, novelty ‘gizmo’ products whose design incorporates environmentally damaging modes of manufacture, consumption and disposal. To bring attention to this growing unsustainable design culture, we have produced a manifesto entitled *Spimes Not Things: A Design Manifesto for A Sustainable Internet of Things*. It is the synthesis of a practice-led research project which explores Sterling’s *spimes* concept using Design Fiction methods, as part of a Research through Design approach. This paper outlines the manifesto’s creation, its theoretical foundations and its intentions. The manifesto is the first step towards the reframing of design practices that will contribute to a more sustainable IoT product paradigm.

Keywords: Spimes, Sustainability, Internet of Things, Manifesto, Design Fiction

1. Introduction

The rhetoric that surrounds the Internet of Things (IoT) across academia and industry is both persuasive and turgid. Many commentators posit that through its expanding array of networked artefacts, sensors and AI capabilities, the IoT will bring about utopian transformative change to all sectors of society, from healthcare and energy, to transport and finance (Government Office for Science, 2014; Fritsch, Shklovski, & Douglas-Jones, 2018). The narratives that pervade sustainable design discourse can be equally bombastic. Often amplifying tropes found within classical philosophy of technology literature from the likes of Mumford (1934), Ellul (1964) and Borgmann (1984), some theorists put forth dystopian visions which predict human extinction, while others look backwards to rose tinted idylls for answers to the unsustainable nadir we now find ourselves in (Thackera, 2005; Fry, 2009; Walker, 2014). While such hyperbole is provocative, it is unhelpful for those attempting to

envision more plausible implications arising from the widespread diffusion of the IoT, particularly in regard to the design of future *sustainable* IoT product-service systems.

As Strengers (2013) notes, much fanfare is made of the IoT's potential utility for reducing energy usage through pervasive monitoring. Yet, we contend, that little discourse recognises the intrinsically unsustainable nature of the IoT devices themselves. Under a façade of innovation, IoT product design culture displays a penchant for superfluous 'gizmo' style devices (i.e. solving problems that do not really exist) which continue to adhere to long established unsustainable modes of mass manufacture, consumption and disposal. Exponents appear so preoccupied as to whether or not they can produce novelty 'enchanted objects', to use Rose's term (2014), that they do not stop to consider the lasting environmental damage resulting from such devices. To bring attention to this growing unsustainable IoT design culture, we have produced a manifesto entitled *Spimes Not Things: A Design Manifesto for A Sustainable Internet of Things*. This paper outlines the creation of the manifesto, its theoretical foundations and its intentions. The manifesto is the first step towards the reframing of design practices that will contribute to a more sustainable IoT product paradigm. The manifesto is the synthesis of a 3 year research project that has explored Sterling's *spimes* concept (2004; 2005) utilising a *Research through Design* approach.

When viewed simply, spimes are a class of near future, internet-connected objects, but unlike the disposable IoT gizmos that permeate our society today, spimes would be designed so that they can be managed sustainably throughout their entire lifecycle, from their initial production to having their components recycled and reused at the end of their life. Thus, spimes aim to make the implicit consequences of product obsolescence and unsustainable disposal explicit to potential users (Stead, 2017). Using *Design Fiction* methods to unpack and concretise the nature of spimes, we have developed Sterling's concept from a 'think piece' on unsustainable technologies into a *multidimensional lens* that design researchers and practitioners can readily harness with the ultimate aim of creating sustainable connected product futures, whilst also critiquing the harmful IoT production and consumption practices that define our present (Stead, 2016; Stead, et al, 2018). In the next section, we will discuss in greater detail how we went about unpacking the spimes concept and further contextualise the notion of near future spime objects as a counterpoint to today's unsustainable IoT devices.

2. The Case for Spimes

The futurist Bruce Sterling coined the term *spimes* in 2004 and augmented concept further in his book *Shaping Things* (2005), describing them 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" (Sterling, 2005, p.11). He also more explicitly outlined spime objects' inherent environmental credentials, envisioning them to be "sustainable, enhanceable, uniquely identifiable, and made of substances that can and will be folded back into the production of future spimes" (Sterling, 2005, p.11). Figure 1 illustrates how an individual spime object is the sum of its 'material instantiation' and 'digital instantiation'. Unlike an IoT device whose material instantiation is only visible to its user, both instantiations of a spime would be explicit and manageable by its potential users. This characteristic helps to make a spime object more of a sustainable proposition than current IoT product-services which are designed to keep their data processes and digital infrastructures hidden from users. Based upon this consideration, a spime might be misconstrued as merely a type of potential internet connected device that would be designed to be more sustainable than present day IoT products. Figure 1 also aims to demonstrate that Sterling's concept is, in fact, much more valuable, as a metaphorical *multidimensional lens* to

draw attention to the highly unsustainable practices that are inherent to contemporary industrial product design and technological device development cultures.

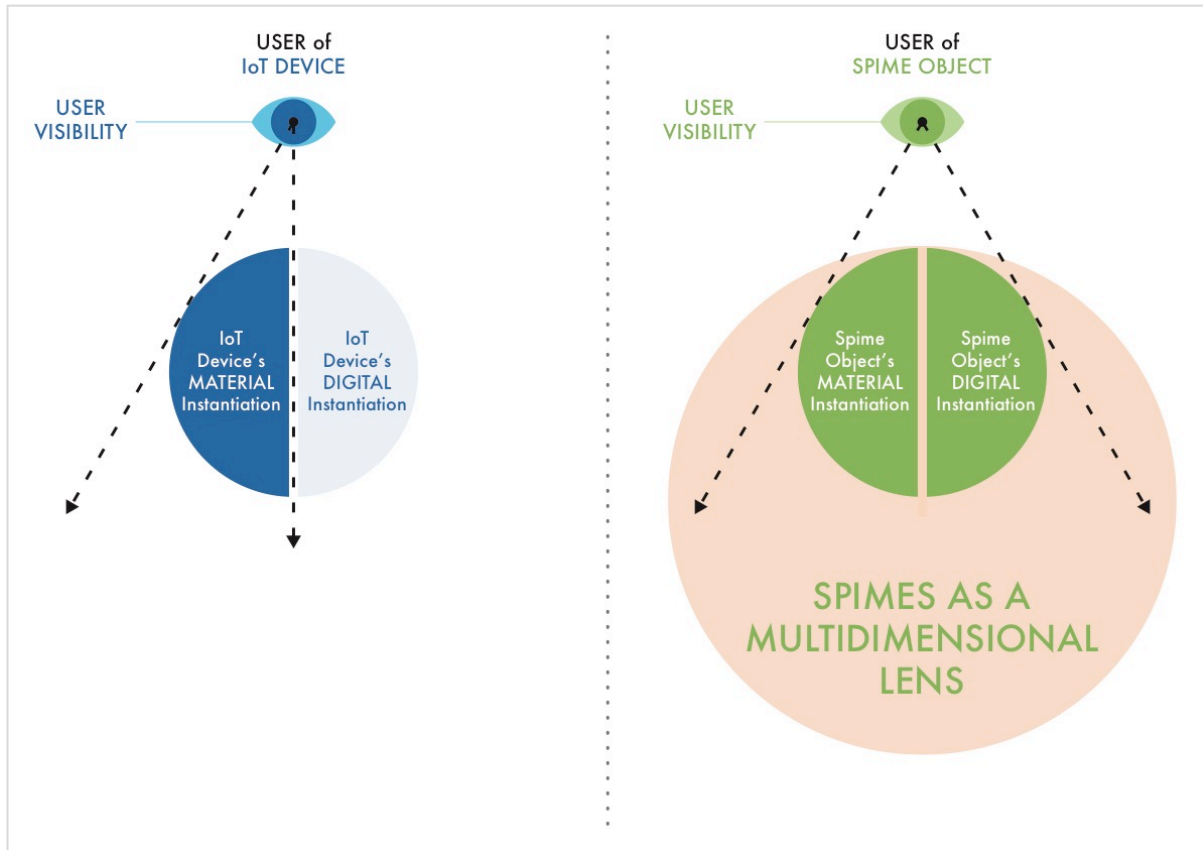


Figure 1. Unlike IoT devices whose material instantiation is only visible to their users, technologically, spime objects would be designed so that their material and digital instantiations would be made explicit to potential users. More importantly, as a concept, spimes should be seen as a rhetorical lens through which it is possible to critique the unsustainability of the IoT.

Like Greenfield and his notion of *everyware* (2006), through spimes, Sterling was beginning to contemplate the possible implications arising from the wanton pursuit of *ubiquitous computing* (Weiser, 1991) by the design industry, product manufacturers, technology firms and indeed academia. The IoT - the idea that computation and connectivity can be made omnipresent and available anywhere, at any-time, using any device - is perhaps the most significant corollary of ubiquitous computing, particularly when one considers the implications for environmental sustainability. The growing availability and affordability of disposable connected devices is evidence that commercial entities view the IoT as principally a profit making enterprise. They do this primarily in two ways: firstly, by selling physical manufactured devices that are imbued with computational capabilities; and secondly, by harvesting and monetising users' personal data that is generated during the use of such devices (Sterling, 2014; Sadowski, 2016). This two-pronged business model ties users to iterative physical-digital ecosystems and is clear to see in the way that firms that were once solely online platforms such as *Google*, now manufacture physical connected products; while more established consumer hardware companies like *Apple* also operate connected digital services like *iTunes* and *iCloud*. These factors begin to raise pertinent questions regarding the long-term environmental effects of the IoT, perhaps most importantly, *how do we sustainably manage the rapidly increasing amount of physical product waste being created when generations of devices are quickly made redundant because they can no longer support the latest digital functionality and/or software upgrades?*

2.1 The IoT As Gizmo Techno-culture

We argue that in response to the IoT's inherent unsustainability and its incessant focus on monetisation, the time is right to develop the spimes concept as a counterpoint, specifically one where the core value to be gained from connecting physical artefacts with digital data processes is *sustainable change*. To better understand this distinction, we created Figure 2 which shows the differences between the key stages of the *lifespan* of a present day IoT device and the envisioned *lifecycle* of a potential near future spime object. One can see that the IoT device's journey is 'cradle to grave' - it is limited, disposable and inherently unsustainable. Conversely, a spime's lifecycle would be designed to be 'cradle to cradle' – cyclical, ongoing and *sustainable*. As Stead (2017) argues, by incorporating planned obsolescence and little to no scope for user repair, customisation or recycling, the design of current IoT products adheres to the same highly unsustainable models of production and consumption that have dominated industrial societies since the end of World War 2. In a spime-based paradigm, physical-digital connectivity would be optimised to enable devices to be trackable and traceable throughout their lifecycle. Making both the material and digital instantiations of spimes explicit would be a way of increasing accountability amongst users, helping them to make more responsible decisions in regard to the types of connected products they purchase, how they use them, and, ultimately, how they go about disposing of such devices. Transparency, coupled with a focus on product disassembly, and recyclable parts and componentry, would be some of the principal aspects of a spime object's design specifications.

Sterling (2005) notes how the development of new technologies not only influences product design cultures but also has a profound impact on societies at large. Using this outline, in Figure 3 we have depicted the most prominent shifts in societal *techno-cultures* throughout human history. *Artefacts* included early technologies such as bespoke farmers tools. The environmental effects caused by the production, consumption and disposal of these early things was miniscule and more transparent than our experience with the today's man-made objects. People were much closer to the means of production and used natural materials which could eventually be repurposed or returned to the local ecosystem. Following artefacts, peoples' things, and the techno-cultures that they helped to shape, evolved into a paradigm Sterling terms *gizmos*. As outlined in the our Introduction, we consider gizmos to be gratuitous and disposable devices. Self-driving baby strollers (Smartbe.co, 2018), connected underwear (Skiin.com, 2018), smart dental floss (SmilePronto.com, 2018); the IoT is a breeding ground for a multitude of gizmo products which are frequently promoted as solutions to real-world problems. In truth, such examples connect *atoms* (the physical) with *bits* (the digital) as a means for commercial gain for their producers and the platforms which harvest their user's data. They offer little meaningful value for users, other than providing short-term novelty and superfluous functionality. In addition, devices like these continue to adhere to extremely complex, obscure and unsustainable modes of mass manufacture, consumption and disposal. Appropriately, in Figure 3 we have positioned today's IoT devices within the *gizmos* techno-culture and characterise such product-services as *unsustainable technological things designed to have short lifespans*.

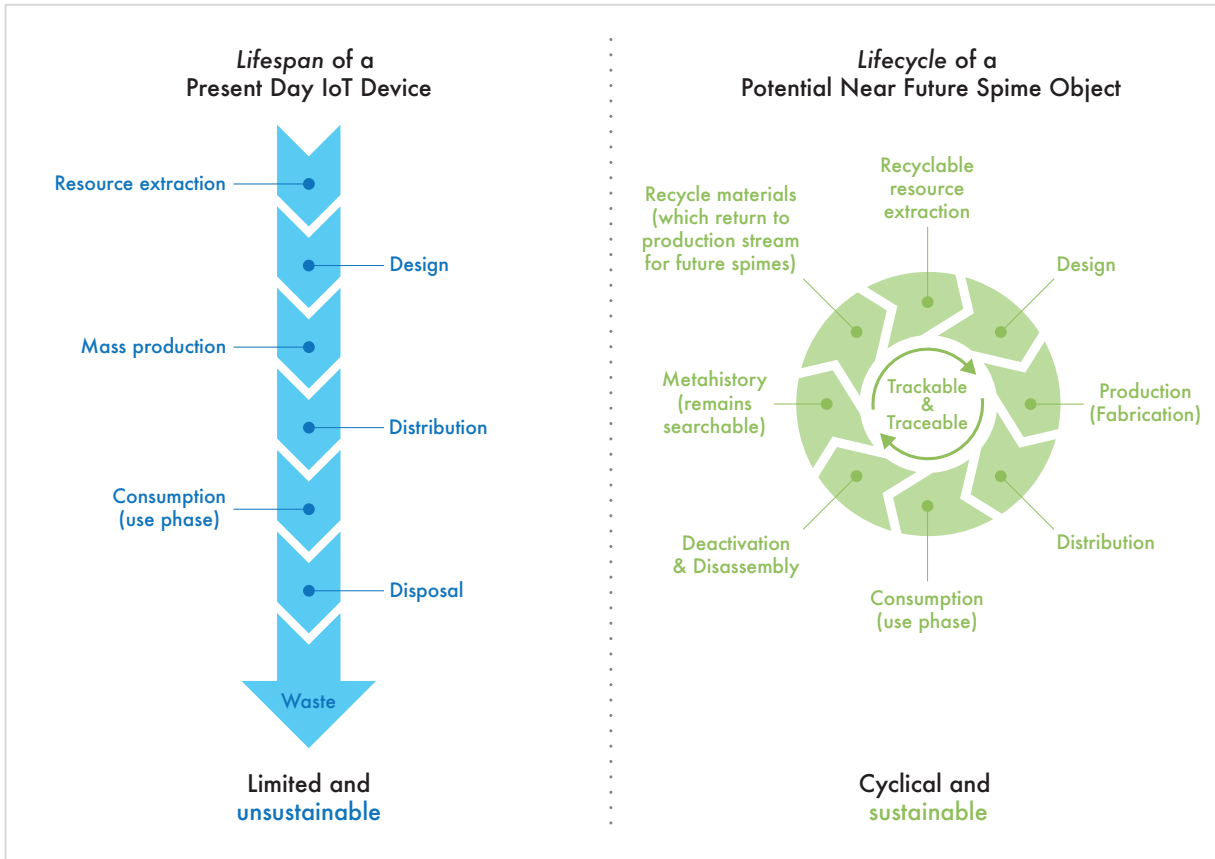


Figure 2. The contrast between the lifespan of an IoT device and the envisioned lifecycle of a spime object.

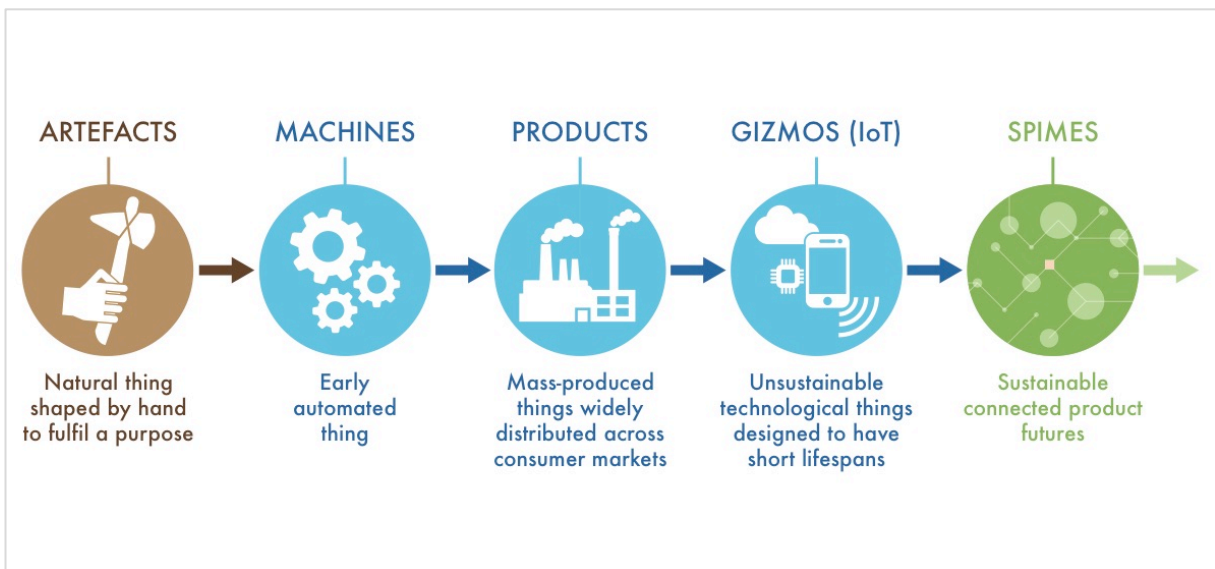


Figure 3. Man-made things have helped shape societies' broader 'techno-cultures' through the ages. With its focus on novelty and disposability, we have positioned the IoT within the unsustainable gizmos techno-culture which would have to evolve significantly in order to shift to a sustainable spime-based paradigm.

Figures 2 and 3 help us begin to understand that the technical specifications, business models, and, crucially, the overriding design logics, that dominate today's IoT gizmo techno-culture, would have to alter significantly in order for industrialised societies to successfully transition into a sustainable spime-based paradigm. *How then do we begin to consider designing spime objects in order to*

highlight the growing unsustainability of the IoT? Whilst Sterling suggests some of their possible technological characteristics, he does not attempt to visualise potential spime devices nor explore the practicalities of incorporating such technologies into their design. However, perhaps the greatest challenge provoked by Sterling’s text is how to effectively embody the critical thinking that spimes represent ‘within’ their design. This said, in the next section, we will discuss how we applied Design Fiction methods, as part of a Research through Design approach, to generate a series of practice-led case studies which concretise key design criteria for potential spimes objects. Further to this, these methods allowed us to develop each study into a broader theoretical lens which we use to underpin our manifesto and critique different aspects of unsustainable IoT design culture.

3. Spime-based Design Fiction Practice

Having determined the reasons for why embracing a spime-like techno-culture is so important, how can we use design practice to help us speculate what such a paradigm might possibly look like? Although we posit that spimes are yet to come into existence, the concept, as Hales (2013, p.6) suggests, should be seen as “a category of imaginary object that is also an intervention in the present and... are ‘forward looking’ akin to the actually futuristic objects they create”. Thus, spimes act *in the present* as they are a *rebuttal* to today’s unsustainable IoT design culture. Consequently, the earliest, near future spime objects would likely share some technological attributes with present day IoT devices. Having said this, spimes would not be a mere extrapolation of nascent IoT technologies and design practices. As we explained in section 2, within a spime techno-culture, the sustainability of its connected devices is as significant as their physical and digital properties. Figure 4 shows how a near future spime object’s design would seamlessly intersect three parameters – physical (atoms), digital (bits) and *sustainability* (the natural environment). All are of equal importance within the spime design process. Moreover, we contend that their confluence can be expanded by what we term the *Spime-based Design Fiction practice space*.

3.1 Spimes and Design Fiction

As with spimes, Sterling (2005) originated the term *Design Fiction* and has since described the method as “the deliberate use of diegetic prototypes to suspend disbelief about change” (cited in Bosch, 2012, para.3). This is an appropriation of Kirby’s (2010) notion of ‘diegetic prototyping’ which denotes how a futuristic object or imaginary product might be rendered ‘material’ and fully functional in ‘diegesis’, in other words, ‘embedded’ within a fictional narrative. Bleecker (2009) asserts that diegesis creates a *discursive space* in which design fiction prototypes are free to challenge peoples’ insular and habituated perceptions and expectations of the role products play in everyday life. Design Fictions visualise prototypes through a wide variety of ‘new media’ including three-dimensional artefacts, graphics, web-based content, computer games, illustration and video/film (Hales, 2013). Alongside the more established field *Critical Design*, the method is grouped within a set of design practices known as *Speculative Design* (Auger, 2013). Dunne and Raby (2013) position Speculative Design in opposition to ‘affirmative’ commercial design practice, which they argue simply reinforces the status quo. Instead of solving conventional design problems such as technical specifications and production cost reduction, speculative practices use designed artefacts to critique ‘affirmative’ design activities (Coulton, et al, 2018). Critical Design aligns closely with

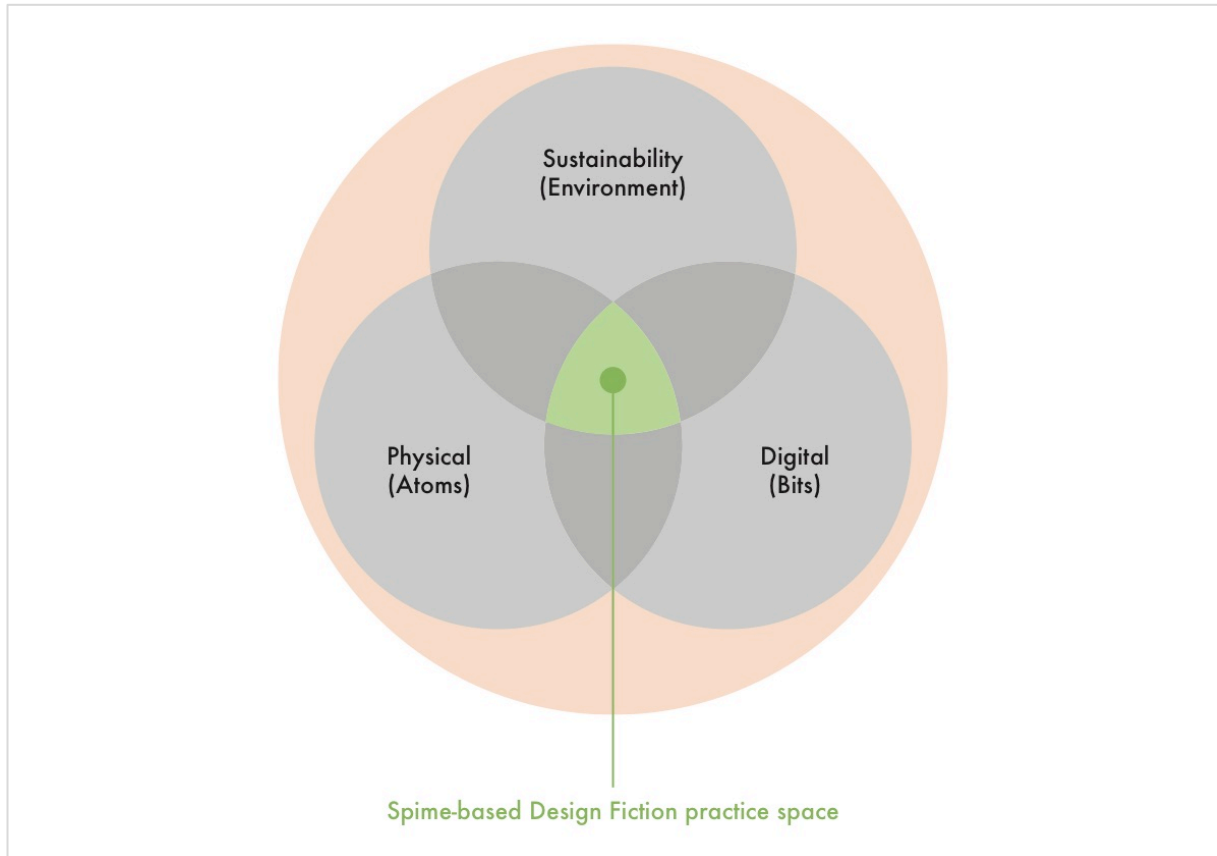


Figure 4. We contend that three parameters are key to the design of near future spime objects – ‘physical’, ‘digital’ and ‘sustainability’. The confluence of the three parameters results in the ‘Spime-based Design Fiction practice space’.

fine art tradition by primarily presenting designs to informed audiences in gallery settings (as with much of Dunne & Raby’s work). In contrast, Design Fiction’s broader canvas of media enables practitioners to pose arguments about potential futures by demonstrating that future in a context which wider audiences can more easily understand (Tanenbaum, Pufal, & Tanenbaum, 2017).

Since Bleecker’s seminal 2009 paper, the production of diegetic prototypes and an emphasis on fictional narrative have remained key tenets of Design Fiction for many working in the field. As we will discuss in section 4, we initially adopted these approaches within our first spime-based design fiction – *the Toaster For Life* – but in our manifesto’s latter two case studies, we then also began to augment them, introducing notions of *implications for adoption* (Lindley, et al, 2017) and *Design Fiction as World Building* (DFaWB) techniques (Coulton, et al, 2017). *World building* in particular has allowed us to concretize and explore future worlds in which different types of spime product-services, and their related practices, might *plausibly* exist. While distant visions of the future can be worthwhile, we contend that plausible, proximate futures are more useful for exploring the mundane and sometimes ‘messy’ implications and values that could arise in a spime techno-culture. People often find it difficult to envisage how disruptive technologies and practices can bring about change that stands apart from their present and previous experiences. We believe that our choice of presentation media, and the way in which it has facilitated us in building mundane worlds creates a degree of plausibility which lessens the potential for the sustainable devices and practices featured in our fictions to appear fantastical, unreal or ‘too futured’. This in turn enables audiences to engage more meaningfully with the broader social, ethical and sustainable consequences of potentially adopting spimes.

3.2 Our Research through Design Process

The progressive nature in which we have explored spimes using Design Fiction is in keeping with our overarching methodological approach, *Research through Design* (RtD). Originally outlined by Frayling in 1993, there remains no definite consensus regards how to pursue RtD. Despite this, we believe our wider RtD process follows Gaver’s (2012, p. 942) interpretation of the methodology, which he argues is “a route to discovery [where] the synthetic nature of design allows for richer and more situated understandings than those produced through more analytic means”. Our process has been a means for *sensemaking* – a way of creating, acquiring and understanding new knowledge regards spimes and the unsustainability of the IoT. As both Figure 5 and our manifesto’s case studies attest, our process has been agile and iterative, combining *cycles of design practice* with *cycles of reflective study*. Through this journey, we have expanded upon the nature of spimes with each case study, developing the concept into a set of rhetorical and reflective lenses, which not only audiences can consider but also ourselves and other designer researcher-practitioners who may seek to envision spime-based futures. This kind of designerly reflection corresponds with Schön’s (1983) notion of *reflection on action*, where in order to gain actionable or some type of generalisable knowledge from our practice, we have had to appropriately reflect on the activity.

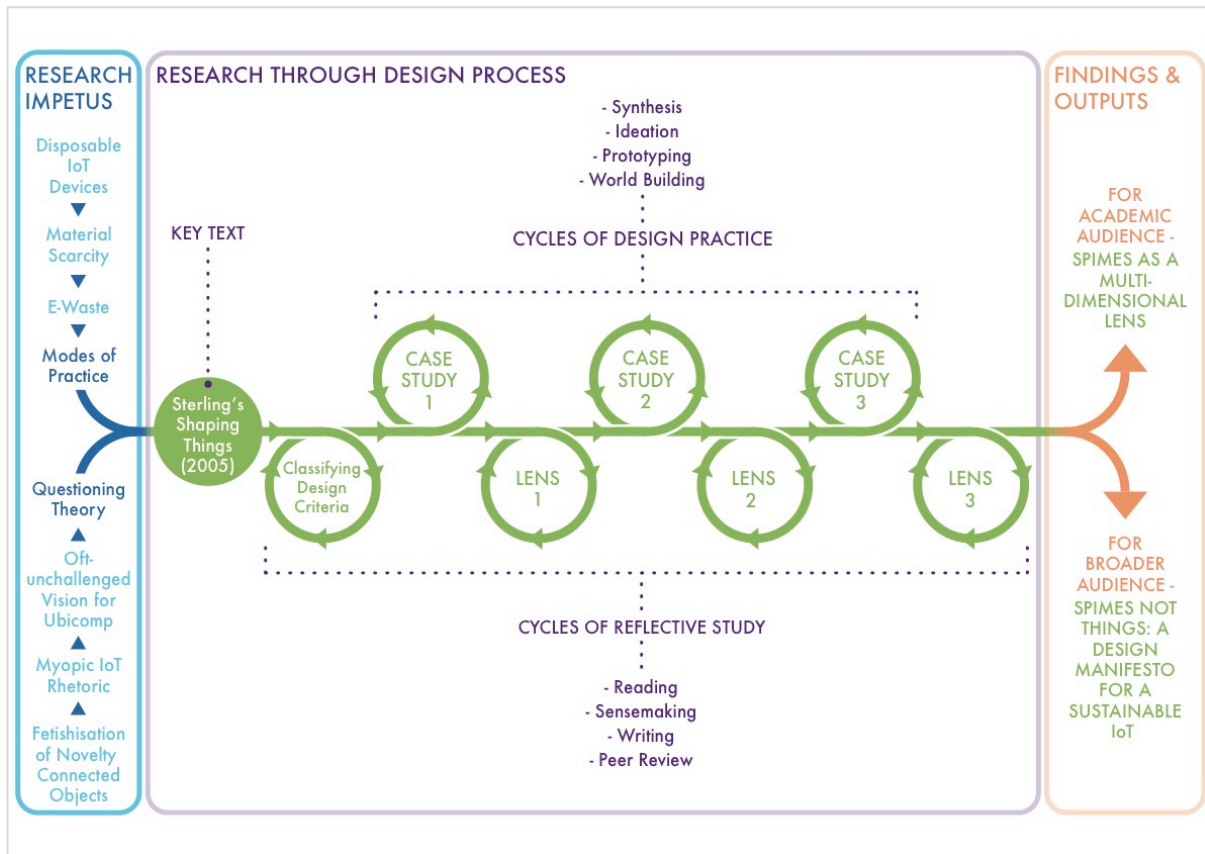


Figure 5. The iterative nature of our broader Research through Design process. The diagram aims to illustrate the interdependence between our ‘cycles of design practice’ and ‘cycles of reflective study’. This reciprocative relationship has led to theory generation in the form of two main outputs.

4. Designing the Manifesto

As noted in Figure 5, we commenced our programme of spime-centred research by first unpacking Sterling’s original text *Shaping Things* (2005). Through this analysis, we identified seven key *classifying design criteria for spime objects*. The criteria are as follows:

1. Context;
2. Sustainability;
3. Technology;
4. Temporality;
5. Synchronicity;
6. Wrangling;
7. Metahistory (Stead, 2017).

In our view, the above criteria are an effective mechanism for distinguishing the design attributes of potential spime objects from that of today's unsustainable IoT gizmos. Accordingly, they provide a technical and theoretical foundation for the three design fiction case studies (produced through our *cycles of design practice*) and the three corresponding critical lenses (identified following our *cycles of reflective study*) that result from our RtD process (Figure 5). In addition to the traditional academic formats, in order to disseminate our spime-based research to a wider audience, we chose to produce a *design manifesto*. The document draws upon our case studies and is built around our three fictional spime prototypes, each of which probe the possible implications of spimes existing within mundane future worlds. Gaver argues that manifestos are a compelling way to represent a body of RtD research, as they “go beyond theoretical treatments drawn from other disciplines or developed from reflection on practice to suggest certain approaches to design as both as desirable and productive of future practice” (Gaver, 2012, p. 938). Figures 6 and 7 depict the manifesto's front cover and introductory pages. We have included key aspects of our research throughout the document but have sought to convey such ideas in a manner with which non-academic audiences, such as product designers, creative technologists, environmentalists and politicians, can engage effectively. The manifesto is therefore reasonably short in length and easy to read. In addition to Gaver's validation, we feel that disseminating our research in this way is also very much in keeping with Design Fiction's adoption of 'new media'. Thus, alongside printed hard copies, we have created a Twitter feed – @SpimesNotThings – through which we will post the manifesto with the aim that it is then actively shared online.

By sharing our practice-led case studies, we seek to help others to consider how they might begin to design spime-like devices and why a refocussing of their design practices in this way could start to build a more sustainable IoT. Crucially, the spime prototypes are intended to be viewed as *exemplars*, and not as 'end products' for production, nor as solutions to the specific unsustainable characteristics of the IoT that each case study critiques. Similarly, they should not be seen as archetypes of how spime objects *should* be designed, but rather, as just three examples of the many ways in which a spimes *could* possibly manifest in the near future. As we have previously discussed with regards to Design Fiction and RtD, although they may appear convincing, our prototypes serve foremost as *provocations* and as embodiments of theory (Stead, 2016; Coulton, et al, 2018). As we will explain further in the following sections, the manifesto uses the case studies to highlight and critique the unsustainable design culture that pervades the IoT, while also envisioning potential, plausible alternatives to current products and practices. In doing so, the fictions seek to emphasise the need for practitioners to shift to more compelling modes of sustainable connected product design.

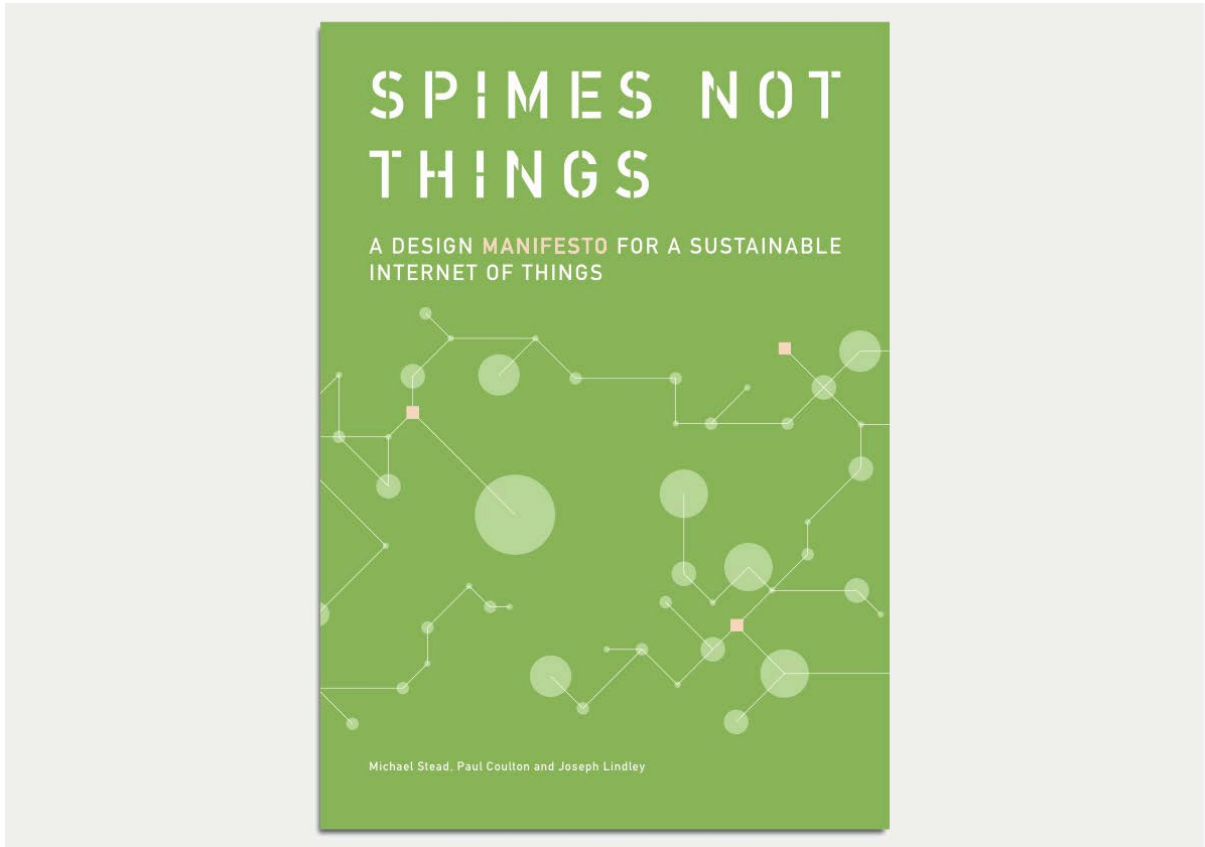


Figure 6. The front cover of our spimes manifesto.

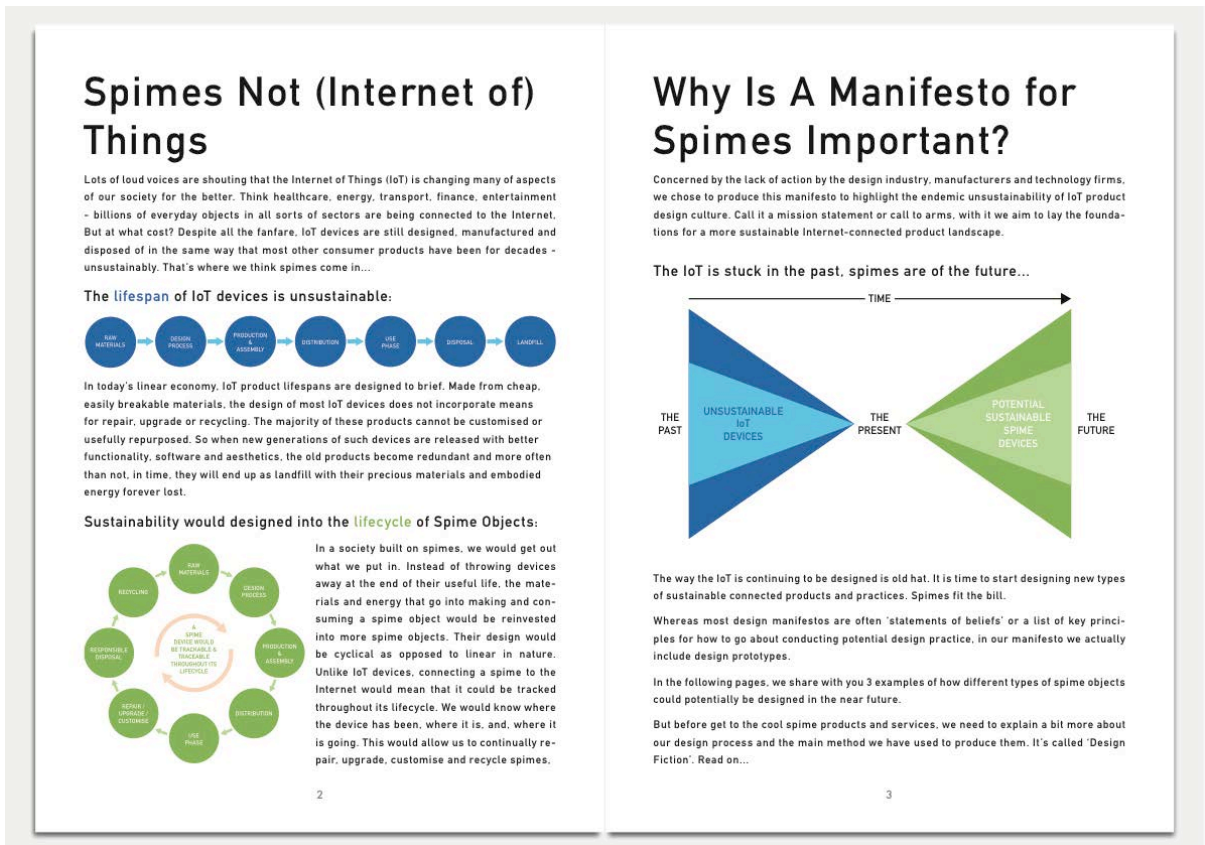


Figure 7. We have included key aspects of our academic research throughout the document but have chosen to present it in manner that broader audiences can more easily digest and engage with.

4.2 Case Study 1: Toaster for Life

The manifesto's first Design Fiction case study – the *Toaster for Life* – embodies the notion of spimes in the form of a banal and ubiquitous everyday object. With its focus on incorporating technological features into a spime object's design to ensure its lifecycle is inherently sustainable, the study explores three of the above key classifying criteria – *sustainability*, *technology* and *temporality*. To create a plausible prototype toaster, we draw on disparities we identified between contemporary sustainable design theory, in particular McDonough and Braungart's *cradle to cradle* model (2008) and unsustainable *centralised* manufacturing processes. To highlight this incongruity, we extrapolated a range of present day IoT technologies including RFID, GPS and 3D printing, married them with fictitious sustainable characteristics, and incorporated them into the toaster's design. Consequently, within the Design Fiction, the 'mass produced' toaster affords effective repair, upgrade, customisation, recycling, and its parts and components are all inherently trackable. To help the prototype to appear to 'exist' within *diegesis*, we framed the design in the manner of a near future product launch catalogue as produced by a fictional connected device manufacturer (Stead, 2016). As we can see in Figure 8, the manifesto emphasises the toaster's sustainable potentialities and uses the case study to provoke questions about how manufacturers might begin to embrace new cyclical product-service relationships with customers – akin to circular economy thinking (Webster, 2015) – as opposed to continuing to integrate *planned obsolescence* into their IoT products' lifecycles which ultimately creates copious amounts of e-waste.

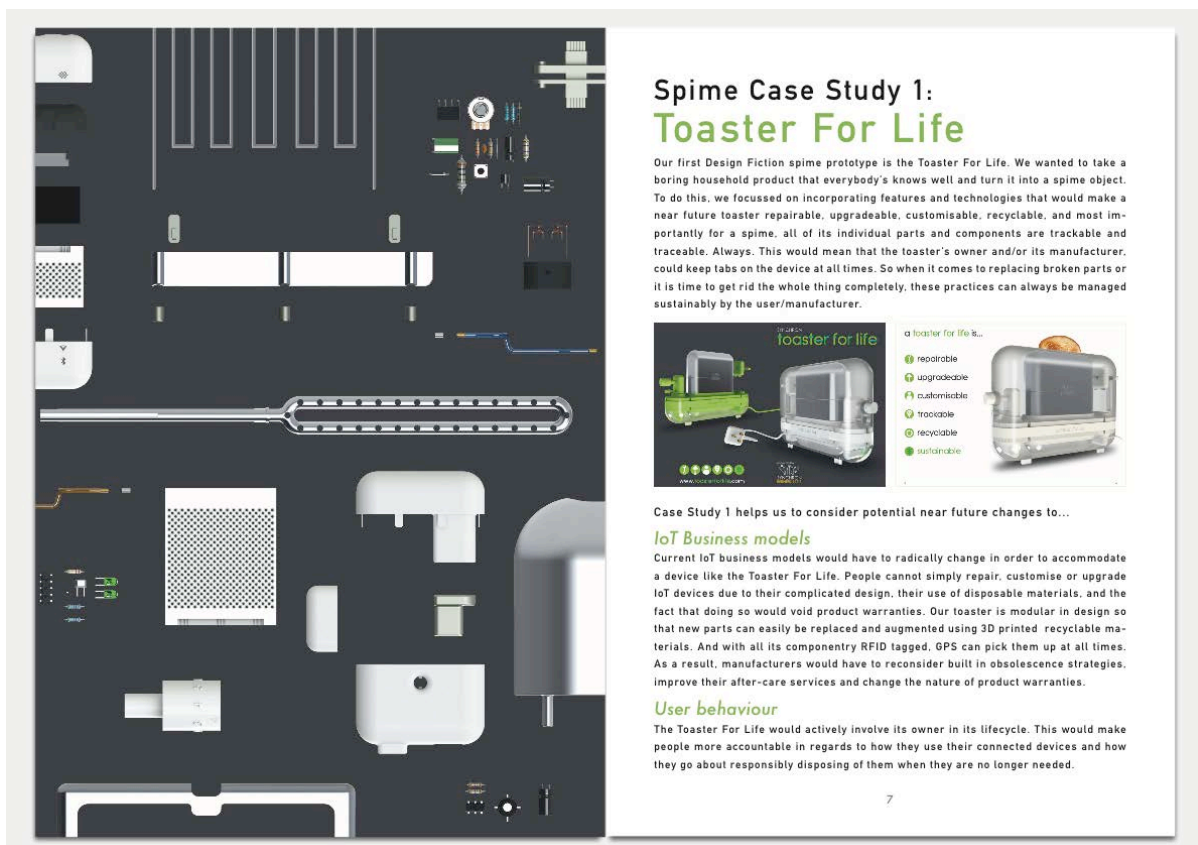


Figure 8. Focussing on technological attributes that might potentially make a spime object's lifecycle inherently sustainable, the manifesto's first case study centres on the *Toaster For Life* diegetic prototype which we framed within a product launch promotional brochure.

4.3 Case Study 2: HealthBand

For our second case study, we wanted to use Design Fiction methods to further unpack the classifying criteria *synchronicity* and *wrangling*. We did this by examining the relationship between *decentralised* and *democratised* design activities and the IoT. In recent years, practices and technologies like open source hardware, crowdfunding and the maker movement have increasingly been cited as a more environmentally friendly alternative to mass manufacture and distribution (Smith & Light, 2017; Kohtala & Hyysalo, 2015). To incorporate these aspects into a spime prototype, we chose to frame our design as a Do-It-Yourself (DIY) medical wearable device called *HealthBand*. Although healthcare providers are now integrating wearables into frontline services, the regulatory journey from consumer use to patient use for these IoT devices is complex and oft protracted due to strict legislation (Stead, et al, 2018). The *HealthBand* fiction enables us create discussion regards how DIY medical devices might become widely adopted through social innovation and localised production channels. Like the *Toaster For Life*, we initially generated a diegetic prototype of the *HealthBand* device. However, in order to better emphasise the broader implications near future DIY medical devices and practices might yield, we chose to adopt DFaWB techniques to contextualise the prototype within a more fully rounded world. In doing so, we generated a range of related artefacts that provide different ‘points of entry’ for audiences to engage with the fictional world. Several of these artefacts can be seen in pages taken from the manifesto in Figure 9. We use this case study in the manifesto as a means to stress the social, ethical and sustainable implications of decentralised design practices and technologies for future product policy and regulation.

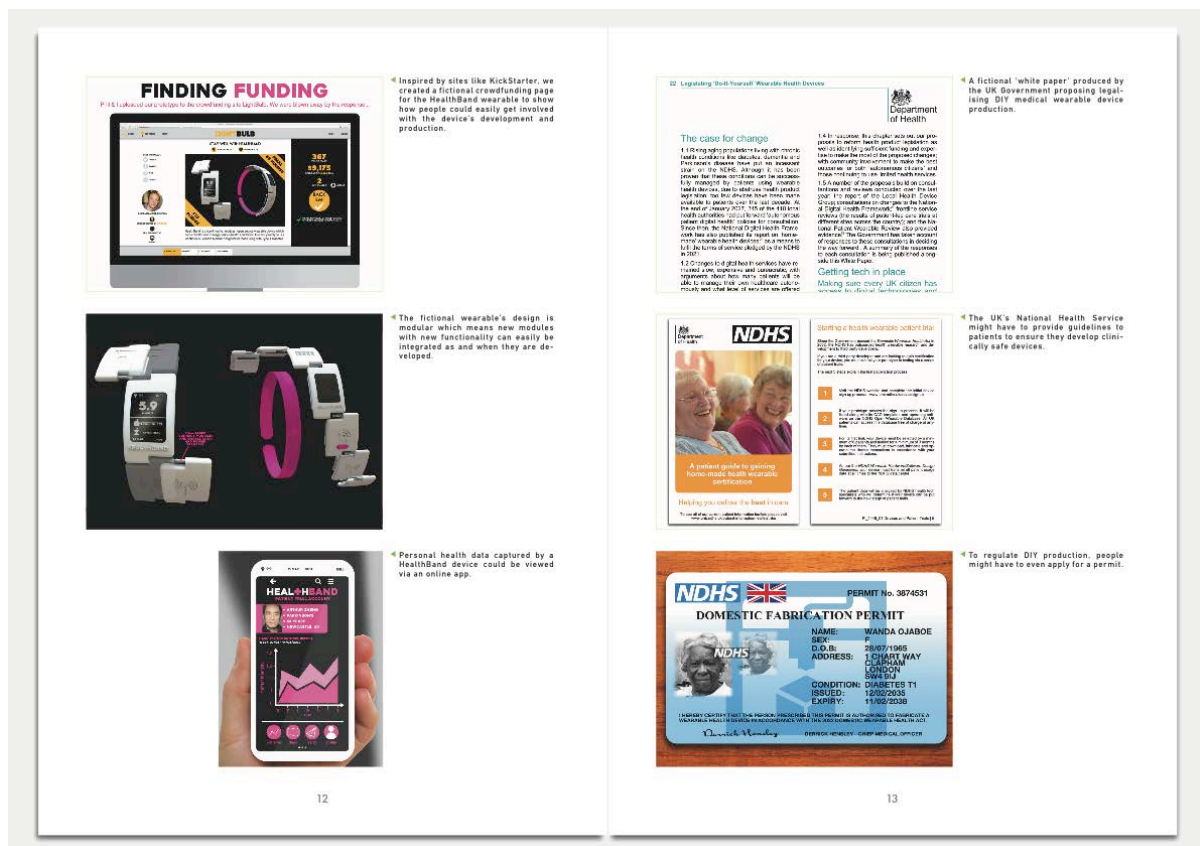


Figure 9. For the HealthBand case study, we initially generated a diegetic prototype. However, to emphasise the broader implications of near future DIY medical devices, we turned to DFaWB techniques to contextualise the design within a more fully rounded world.

4.4 Case Study 3: The Future Is Metahistory

Our third study, *The Future Is Metahistory*, explores the metahistory criteria by focussing on the possible sustainable implications of the data driven 'digital instantiation' of a spime. This contrasts with the *Toaster For Life* and *HealthBand* studies whose prototypes and related artefacts primarily embody a spime object's physical, 'material instantiation'. A spime device would generate important data about itself throughout its entire lifecycle and this *metahistory* would be saved and remain searchable, trackable and mineable at any-time. As Figure 10 details (left hand side), within the fiction, the Government's so called 'Open Traceability Protocol' enables citizens to use blockchains to share their spime devices' metahistories. A blockchain is a public yet highly secure digital ledger containing transaction data between various parties. We designed a series of fictional artefacts that help us to concretise a near future world in which new practices have developed as a result of a metahistory/blockchain alliance, such as the secure trade of data rich spime objects, the use recycling apps to search for replacement componentry, and the accessing of products' provenance information, that is, to see how a spime has been used by its previous owners. We are aware that some present implementations of blockchain are known to have a substantial detrimental impact on energy resources, the prime example being its facilitation of Bitcoin's data mining processes. As blockchain is an emergent technology, we argue that these important but early concerns are yet to be properly resolved. Moreover, a core precept of practising design fiction is the capacity to elicit potential *implications for adoption* in regards to new technologies (Lindley, et al, 2017). Consequently, the manifesto uses this study to highlight the growing problem of material scarcity and to ask whether increased data transparency as supported by blockchain would place greater accountability upon designers and producers in relation to the resources they deplete to manufacture connected products, as well as making these issues more explicit to the users of such devices. In addition to this, with present day concerns surrounding internet service providers harvesting and monetising peoples' personal data (Sadowski, 2016), the fiction aims to also open up debate regards the regulation of access to connected product data and for what purposes said data may be used.

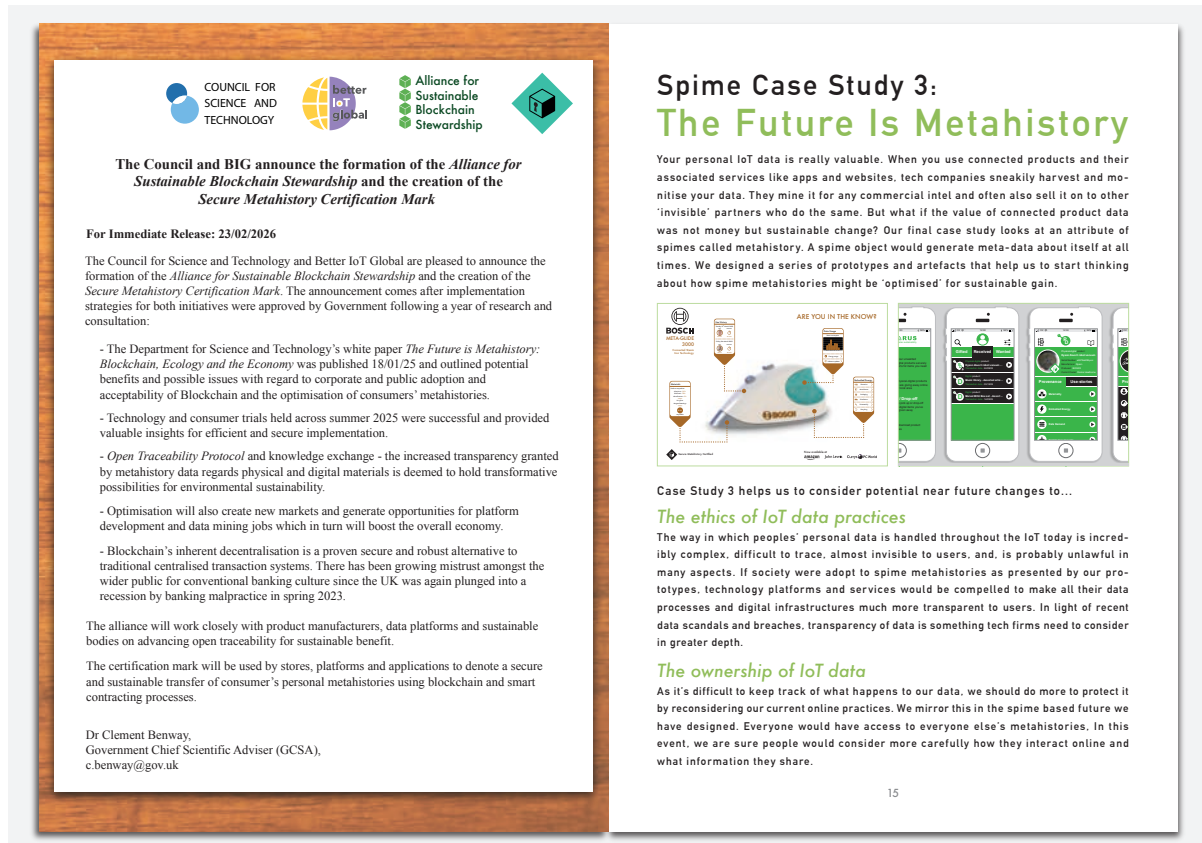


Figure 10. Our final case study – *The Future Is Metahistory* – incorporates a diverse range of artefacts which act as ‘entry points’ to the constructed spime-like world. The study explores the potential impacts that greater transparency and tracking of spime data could have on material scarcity. This framing also helps us to form a third lens which can be used to discuss the ethics of sharing connected product data and the ownership rights of device users.

4.5 Forming a Multidimensional Lens for Spimes

As is shown in Figure 5, during our RtD process, each *cycle of design practice* was followed by a *cycle of reflective study*. The latter would involve periods of sensemaking, further reading and academic writing. Each reflective cycle culminated in the production of a peer reviewed paper which both outlines and reflects upon the preceding cycle’s practice-led case study. It was through the writing of these papers that we were able to identify three, distinct theoretical lenses (Figure 11). Based on *Case Study 1* and our corresponding paper discussing the *Toaster For Life*, we formed *Lens 1: Business models and Behaviours*. From *Case Study 2* and work on the *HeathBand* prototype, we developed *Lens 2: Policy and Innovation*. Finally, following *Case Study 3* and *The Future Is Metahistory* fiction, we identified *Lens 3: Ethics and Ownership*. Having explored the classifying design criteria through practice in the three case studies, they consequently also manifest in the diagram, this time intersecting all three lenses. Crucially, the lenses are wider in scope than the classifying design criteria. If we cross-reference Figure 11 with Figure 1, while the criteria centre on particular sustainable design *attributes* of a spime object (in other words, they are primarily concerned with the design of a spime’s material and digital instantiation), the lenses’ consider the broader sustainable, societal and ethical *implications* of adopting a spime techno-culture. Figure 11 also makes evident that a synthesis of the three individual lenses results in the formation of an overarching *multidimensional lens* for spimes. It is through this lens that we are able to demonstrate that spimes as a concept, is, in actuality, concerned with more than the design of near future connected devices. Spimes can, as we have demonstrated through our work, be applied as a credible

and purposeful rhetorical lens within practice-led research. Indeed, there remains space on Figure 11 for further lenses should we and/or other researcher-practitioners wish to elicit them.

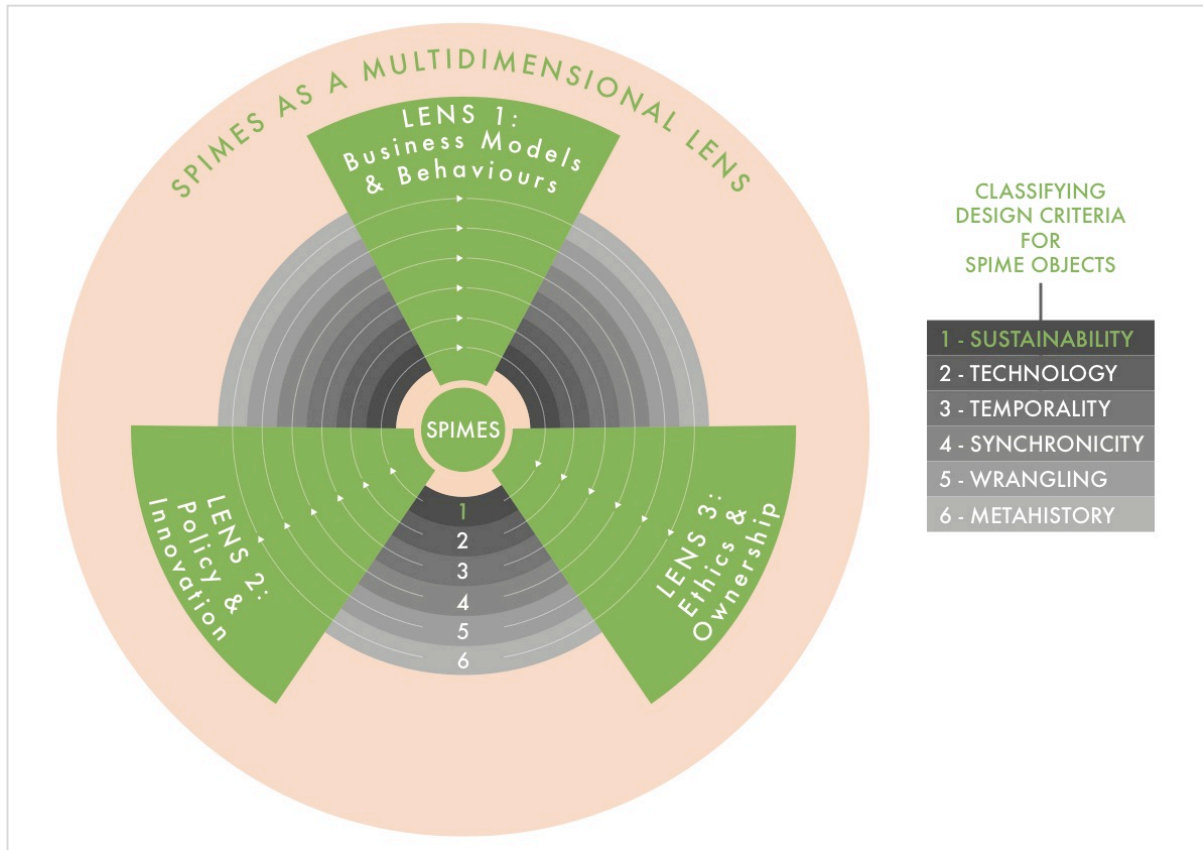


Figure 11. Following each design fiction case study, we identified a set of three, broader theoretical lenses. The ‘classifying design criteria’ run through all three lenses, which, when viewed together, form the macro ‘Spimes As A Multidimensional Lens’.

4.6 Key Messages Not Commandments

Other design manifestos can be very prescriptive, in that, they often present a list of commandments which audiences are advised to follow in order to generate the ‘perfect’ design outcome, or even to ascertain a greater philosophical perspective on the nature of design praxis. Although they can sometimes inspire creative outcomes, we argue that famous design tenets, such as Dieter Rams’ *Ten Principles of Good Design* (Rams, cited in Klemp and Ueki-Polet, 2010) and Donald Norman’s *Principles Of Design* (Norman, 1988), could be described as ‘heavy handed’ and advocate design requirements that are, more often than not, unobtainable in practice. In line with both the provocative nature of our Design Fiction studies and our iterative RtD process, we chose to not include a list of ‘static’ commandments within our spime manifesto. As one can see in Figure 12, we instead conclude the document with 6 *Key Messages*. Our three lenses provide the basis for these messages but we once again chose to convey such theory in a more digestible format to enable non-academic audiences to more readily consider them.

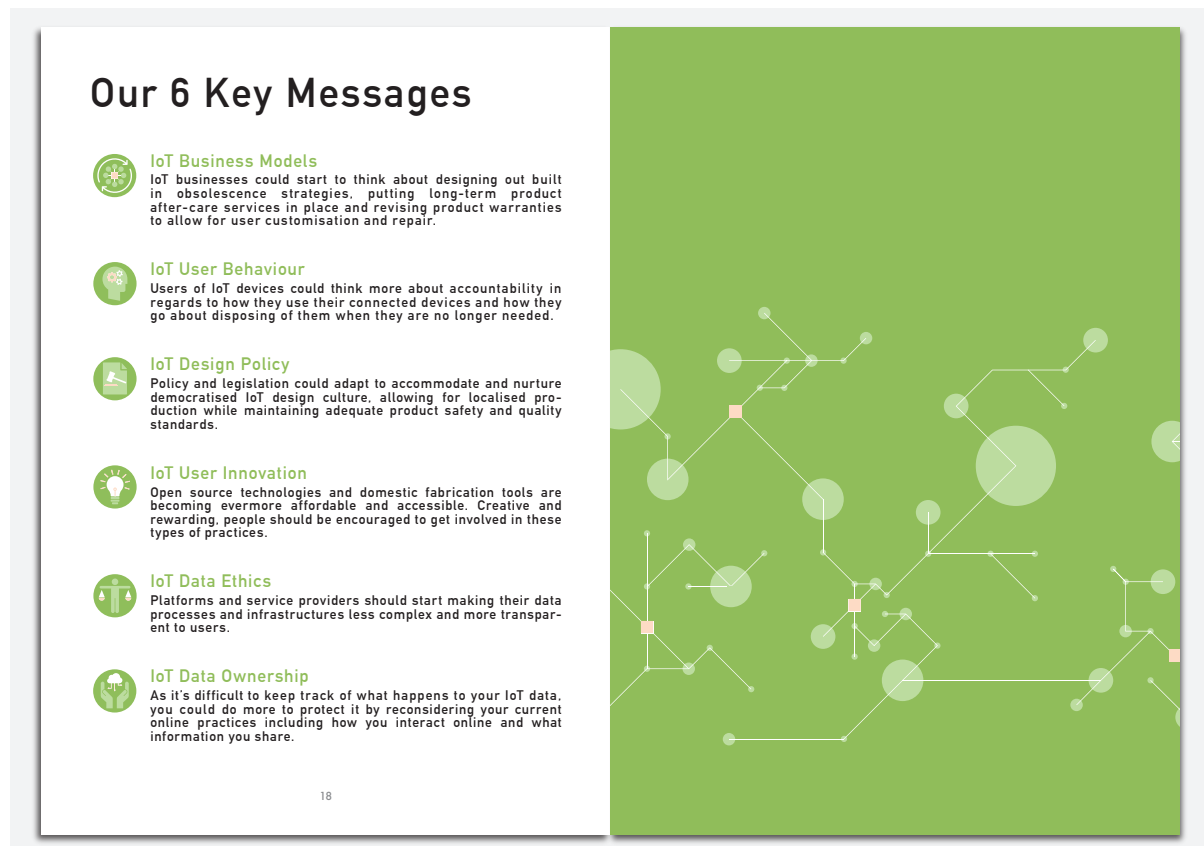


Figure 12. Our manifesto's '6 Key Messages' (left hand side of image). These messages represent the three lens that we identified from each of our case studies, albeit in a more easily digestible form.

5. Conclusion

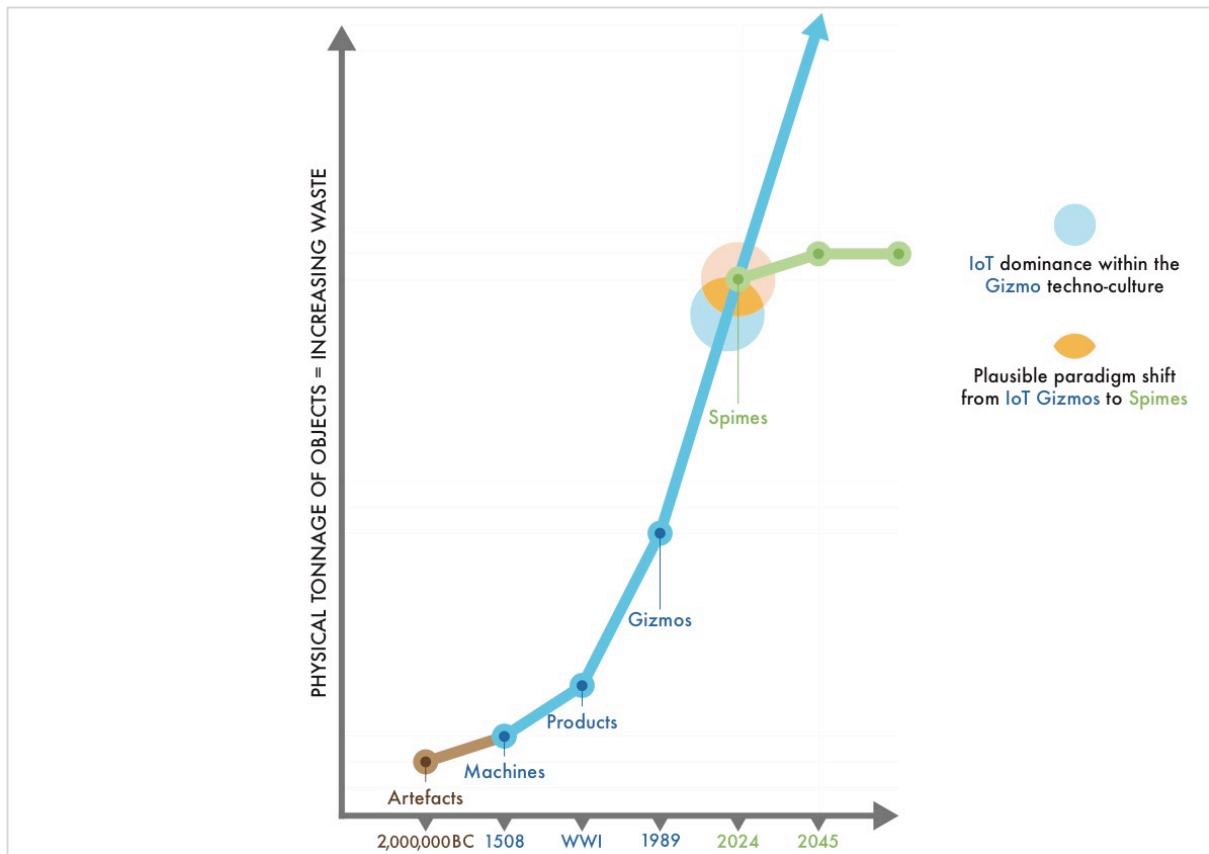


Figure 13. Shifts in techno-culture has led to an exponential rise in the number of physical objects being produced, which, by default, has resulted in ever increasing amounts of product waste being created. We contend that unless challenged, the IoT will continue this trend unabated. We posit that through the application of spimes as multidimensional lens, design researchers and practitioners can start to reframe their design practices around a more sustainable IoT product paradigm.

Based on Sterling's text, Figure 13 seeks to emphasise how the shift to each new pervading techno-culture has led to an exponential increase in the number of physical devices being produced. We have revised and augmented the graph to illustrate that each shift has also resulted in ever-greater amounts of unrecyclable physical product waste being created. We have included the recent emergence of the IoT within the gizmos techno-culture, and show how, unless sufficiently challenged, IoT gizmos will continue unabated on their unsustainable upwards trajectory (blue). We have also added a second trajectory (green) which denotes a spime-based paradigm emerging from today's IoT gizmo landscape (yellow). We envisage that a transition to a cyclical and more sustainable spime techno-culture in the near future could significantly reduce the numbers of disposal connected devices being created and thus redirect connected product design cultures onto a more sustainable and even path. Our corpus of spime-centred research seeks to embody this stance. We have shown that, by using Design Fiction methods to build mundane, near future worlds in which spimes plausibly exist, design researchers and practitioners can begin to apply spimes as a multidimensional lens to help reframe their design practices around the creation of a more sustainable IoT product paradigm.

With our manifesto, we also aim to disseminate the above insights to wider audiences who may have a particular interest in sustainable design, the IoT and design fiction practices. Fritsch, Shklovski, & Douglas-Jones (2018) argue that the recent increase in the number of IoT-centred manifestos is a reflection of the growing societal and cultural anxieties people have about the accelerated and

disruptive nature of technological change. We have indeed created our manifesto in response to the increasing unsustainability of the IoT which is primarily due to its culture of exploitation of novel technologies which culminates in the production of superfluous gizmo devices. We argue however, that having focussed on exploring mundane, plausible spime near futures through robust design fiction practice and peer reviewed case studies, our manifesto is not based upon hyperbole or empty rhetoric. With its aim to both highlight the said growing issues surrounding the IoT and to also act as a provocation, it would be fair to describe our manifesto as a ‘call to arms’ or ‘mission statement’. And while we have made the case that it is non-prescriptive and not an example of ‘best’ practice in regard to designing spime objects, our manifesto is certainly representative of a pro-sustainability ideology. Throughout our research we have presented spimes as a positive lens, as a positive step towards sustainable connected product futures. We understand and concur with Buchanan’s (1985) notion that all design practice embodies the rhetorical stance of the designer(s). In light of this, despite displaying a pro-sustainability bias, we maintain that our spime case studies are not *preferable solutions*, nor are they visions of a *sustainable utopia*. They are *plausible provocative rhetoric*. Fundamentally, as our RtD process attests, our spime-based design fiction practice has enabled us to unpack and concretise Sterling’s concept in a manner in which we would not have been able to do through theory alone. Further, by focussing on relatable and plausible spime-based futures, we contend that the manifesto acts as a valuable jumping off point for others to begin designing for the sustainability that the IoT, and our civilisation, desperately needs.

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