

Social Design Fiction. New Methods for the Design of Emerging Technology.

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Abstract: There is no shortage of Emerging Technologies all vying for our attention; a recent example of this is 3D Printing. However, a great deal of this technology fails to deliver on its potential. The implications of these technologies on our everyday lives are often very difficult to envision and even more difficult to predict, so the difficult questions surrounding social adoption and the domestication of these technologies are often absent from the discussion. We describe new design methodologies that seek to resolve this issue and discuss existing studies in the 'real world', to highlight the key challenges and opportunities for this method. We then describe the findings of two workshops, to discover how the public envisage they will engage with 3D Printing technology in the future. Ultimately, this paper highlights how Design Fiction can contribute to resolving key social challenges associated with the widespread adoption and exploitation of emerging technology.

Keywords: Design Fiction, Speculative Critical Design, 3D Printing, Social Design

1. Introduction

We are all familiar with emerging technology being accompanied by a great deal of hype, making claims such as '*x is the future of y*' or '*how x will change the world*', but these technologies are often developed in a vacuum. That is to say, that whilst these technologies represent technological breakthroughs, that solve specific technical problems, the claims relating to possible widespread implications and applications in a variety of domains are often less considered. The key point here is that the implications of these technologies on our everyday lives is often very difficult to envision and even more difficult to predict, and as a result, the difficult questions surrounding social adoption and the domestication of these technologies are often absent from the discussion. This is problematic when attempting to road-map the future development of new technologies that do not belong to an existing market.

A good example of this phenomena is '3D Printing', which in 2012 became a cultural buzzword with media headlines such as 'How 3D Printing will change the world'. Seven years on, this potentially transformative technology has yet to deliver the impact that many predicted. We argue that there are two reasons for this: Firstly, the technology itself is still maturing and requires technical

developments to reduce costs, reduce the time needed to ‘print’ physical objects, and expand the available palette of materials, etc. Secondly, work is needed to better understand what people really want, and to some extent expect from this technology. Specifically, whilst there are several known and well-trodden application areas that will benefit from advanced 3D printing technologies, such as bespoke medical devices (e.g. prosthetics, dental), complex machine parts for aerospace engineering, and highly elaborate geometries for sculpture and design; it remains unclear if and how 3D printing technologies may impact our everyday lives. This makes it difficult to focus on specific research for possible applications of the technology, and as a result the market is awash with different 3D printers, all claiming to be world changing.

The main challenge to better envisioning and evaluating the social futures of these technologies relates to the lack of suitable methods for engaging with a broad spectrum of stakeholders, in order to understand what people’s real needs and interests in the technology are at the earliest stages of the technology’s development. Much has already been written about Co-Design and Participatory Design (Bernarda, Ferreira, Silva, & Queiroz, 2017; DiSalvo, Louw, Holstius, Nourbakhsh, & Akin, 2012; Knutz, Ulv Lenskjold, & Markussen, 2016; Pollastri, Cooper, Dunn, & Boyko, 2016; Sanders, 2000), this paper describes an approach using Design Fiction, an approach that operates outside of commercial control and so is able to ask the difficult questions (Mitrovic, 2017).

First, we will describe new design methodologies that allow us to tackle the difficult questions surrounding social adoption and the domestication of new technologies. We will then discuss existing studies that have taken place in the ‘real world’, to highlight the importance of public engagement and reveal key challenges and opportunities for this method of upstream engagement. We then describe the findings of two workshops that have taken place, with the aim of discovering how members of the general public envisage they will engage with 3D Printing technology in the future. Finally, we conclude by discussing the findings and the key insights gained from these events which suggest that design fiction is a potentially useful method for enabling and encouraging a discourse around the social futures of technology. Ultimately, this paper seeks to highlight how design fiction can contribute to resolving key social challenges associated with the widespread adoption and exploitation of emerging technology.

2. Background

3D Printing is considered an *Emerging technology*, this can be defined as a technology that is new, innovative, and still in development, but is expected to have a large socioeconomic impact (Brey, 2017). What is less defined however is how we unlock the potential impact of these emerging technologies and which are the most effective design methods to achieve this.

Towards the end of the 19th century the breach between art and science was viewed as unsustainable (Celi & Formia, 2017), with philosopher Vilem Flusser recognising that:

The word design came to fill the gap and bridge together both branches (art and science) [...] It (design) could do this since it has an expression of the internal connection between art and technology. Hence, in contemporary life, design more or less, indicates the site where art and technology (along with their respective evaluative and scientific ways of thinking) come together as equals, making a new form of culture possible. (Celi & Formia, 2017; Flusser, 1999)

Design can be handled as a technical discipline, manipulating tangible elements such as form, function and the materiality of a product, alternatively it can focus on the cultural, intangible elements such as value and meaning (Celi & Formia, 2017).

Whilst design literature may make it seem as though designers are entirely free to choose how a product or building or artefact will be shaped, we all really know that cultural assumptions, legal mandates, and other social forces exert considerable influence on technological innovation, often without the participants being aware of all of the background influences (Woodhouse & Patton, 2004). As Wiebe Bijker and John Law note: “Our technologies mirror our society. They reproduce and embody the complex interplay of professional, technical, economic, and political factors” (Bijker & Law, 1992). Put simply, designers have to proceed in terms of their own understanding of the world, and their ideas have been shaped by their own individual experiences, design education, and demographic positioning. What “makes sense” to the designer will most likely be in accord with the designers’ tacit assumptions, which may not be the same as those persons who are intended to be the end users.

An obvious counter to this would be that public concerns about design outcomes might appropriately be taken up in a public way, rather than the responsibility laying solely at the feet of designers, this might be termed “design by society” (Whiteley, 1993). This then raises the question ‘how might design move into public debate, systematic inquiry, and institutional practices in unprecedented ways?’ (Woodhouse & Patton, 2004).

The process by which emerging technology is designed is important if it is to achieve its potential. The study of the social shaping of technology is called Science and Technology Studies [STS], this is concerned with the area between two commonly held perspectives concerning technology. The first position of technological neutrality maintains that a given technology has no systematic effects on society, because technologies are merely tools people use for their own ends. In contrast, the second position of technological determinism maintains that technologies are understood as simply and directly causing particular societal outcomes. STS scholars view this as an over simplification as it does not allow the consideration of the complex causation of how people and technology interact. A better tool for this purpose is the concept of valence, a bias in a system, even an individual tool, that tends to interact in similar situations in identifiable and predictable ways. Described in this way, particular tools or technologies tend to be favoured in certain situations, can be expected to perform in a predictable manner in these situations, and have a tendency to bend other interactions to them (Woodhouse & Patton, 2004). This further highlights the need to explore new means of ‘design by society’.

To create this new space, we need to respect the ideas and desires of everyday people. This people centred design is “a process of discovering possibilities and opportunities, with people, that address their needs and aspirations for experiences” (Sanders, 2000). Several methods have emerged in recent years that attempt to exploit this idea. Critical Design [CD] is one such method that can be used to increase societal awareness, by presenting a “possible set of future consequences associated with a particular issue” (DiSalvo, 2009) to allow the social and/or ethical implications of a technology to be considered (Kerridge, 2009). Closely related to this method is Design Fiction [DF], a term attributed to Bruce Sterling who described this as “the deliberate use of diegetic prototypes to suspend disbelief about change” (Bosch & Sterling, 2012).

These novel efforts to link Science Fiction [SF] with emerging technologies go by various names including Speculative Critical Design [SCD] (Dunne & Raby, 2013; Mitrovic, 2017), Design Fiction [DF] (Bleecker, 2010; Bosch & Sterling, 2012), Science Fiction Prototyping [SFP] (Bell, Fletcher, Greenhill, Griffiths, & McLean, 2013; Graham et al., 2015; Johnson, 2010) and Interaction Design [ID] (Petrelli, 2017). Whilst each method differs slightly in its approach, they all use realistic technological possibilities to imagine worlds in which they might be used. These worlds can sometimes emerge from a design or from a narrative; sometimes they are presented together and in others one is

presented in order to provoke the other; in other instances the presence of science fiction is not explicit, but the affinities are still clear (Turney et al., 2013). In each instance the aim of the method is to make use of imagined futures to question, challenge and refine our thinking about the design of technology and innovation.

Intel's futurist Brian Johnson is a proponent of SFP, a methodology that he describes as using "science fiction based explicitly on science fact as a design tool in the development of technology". The addition of a narrative functions as:

A virtual reality in which the implications, problems and benefits of the technology can be explored. This exploration could uncover both best case and worst case scenarios but it can also explore the subtleties of how people will use and interact with the technology. (Johnson, 2010)

This raises the two key questions for Johnson: "Can we use science fiction as a means for understanding and exploring science before it is invented? Can we use science fiction as a tool for the development of science fact?" (Johnson, 2010). In his essay *Science Fiction Prototypes*, he expanded upon this, saying:

Science fiction prototypes allow us to create multiple worlds and a wide variety of futures so that we may study and explore the intricacies of modern science. They are a powerful tool meant to enhance the traditional practices of research and design. (Johnson, 2009).

So whilst there is clear potential for engaging the public (the intended users) in the design process and the cultivation of a broader understanding of socio-technical systems, the majority of speculative design work is still found in a gallery, closer to the art world than the wider public it is intending to engage (Strange Telemetry, 2015b). Similar criticisms are shared by Tobie Kerridge who points out that whilst SCD practitioners aspire to articulate fresh routes through technoscientific landscapes and present these reappraisals to the public through exhibitions and publications, there is the unanswered question of "who is involved in debate here, what kinds of debate take place and what are the effects?" (Kerridge, 2009).

STS literature is also sceptical of the claims made for these enlightened and participatory styles of engagement (Irwin & Michael, 2003; Wynne, 2006). Kerridge goes on further to say the idea that speculative design engages the public and enables debate needs to be grounded in the analysis of actual events. Kerridge notes that frequently, designers' and curators' claims for practice are rhetorical and anticipatory, and are not supported by analysis of the circumstances of making, installing, exhibiting, and promoting designs. Kerridge is therefore sceptical of claims made for the effects of SCD by its practitioners, which often suggest that the creation of a network for exhibitions and other public events, enable the critical discourses that inform their design work, to become more widely available as a form of public debate (Kerridge, 2015). What is needed then is for SCD & DF to leave the confines of the gallery and take place in the public realm, to better engage with the very people it claims to.

3. SCD & DF in the Real World

Carl Disalvo discusses Critical Designs ability to construct the public by "increasing societal awareness, and motivating and enabling political action" (DiSalvo, 2009). Disalvo explains that by presenting "a possible set of future consequences associated with a particular issue" the social or ethical implications of these technologies can be considered (Kerridge, 2009). Whilst this is the promise of these design methodologies, Disalvo sees the opportunity for further work to answer the

question “Does the contribution of design to the construction of publics really matter?” and if so “When?” and “How?” (DiSalvo, 2009).

This question, and others, were explored by the project Material Briefs, which aimed to make laboratories accessible to non-specialists, in an effort to test out upstream interaction between science and social science (Doubleday, 2007). Traditionally there is a linear model of scientific innovation, one where science research leads to a new technology that provides a benefit to a patient. This represents a clear division of labour, between those that develop the technologies and those that use them (Wynne et al., 2007), but there is the inference that alternative regimes of innovation might support “new forms of interaction between scientists and other actors” (Wynne et al., 2007).

Reflecting on the outcomes of this project, they noted that there were three main criteria through which they could be considered. Firstly, that of the relationship between the designer and the researcher; secondly the extent to which the functionality of the design enables experimental forms of practice; and thirdly, to what extent does the design seek to provide alternative means of research.

Kerridge states that the strength of speculative design is “its disengagement from engagement keeps the conceptualisation and evaluation of technology talk loose.” He argues that “rather than talking about creating debate, designers could admit to a less authoritative and central role, accept the proliferation and indeterminacy of their concepts, and commit to providing an account of this variety” (Kerridge, 2015). He further states “crucially, though speculation also does not explicitly link into some later mechanism, such as the formulation of policy. Rather, speculative design offers a practical critique of public engagement’s assumptions” (Kerridge, 2015).

Kerridge acknowledges that for speculative designers there is perhaps a discomfort in treating their own work critically, a belief that in some way analysis could diminish the prestige granted by the circulation of a finished design. He urges however that the discomfort experienced by speculative designers as they adopt an analytical mode, is in fact productive. Kerridge hopes that this will lead to a “conceptually rich and much expanded account of practice that is legible to other designers, academics and project partners” (Kerridge, 2015).

The research collective Strange Telemetry have a very different view on the practical uses of SCD. They believe the benefits of creating artefacts are their ability to give people a tangible way to think about an unknown future, this then enables researchers, managers or policy makers to observe how people respond to and how they feel about the ideas that are embedded within these futures. They were commissioned by the Government Office for Science and Policy Lab, to generate qualitative evidence as part of a larger project concerning the future of an ageing population. This was used as ‘an opportunity to begin developing tools to bridge speculative design, policy, and strategic foresight, as well as facilitating public engagement with the complex, messy realities of socio-technical systems’ (Strange Telemetry, 2015b).

Through their project *Scenescene*, they sought to combine the best practices in public engagement with SCD’s emphasis on specific designed objects and artefacts. The future visions that they produced were intended to provoke reactions, through a guided discussion. The images were intentionally designed to be not overly ‘future-y,’ as the greater the inclusion of robots and similar fantasy technology, the greater the level of cognitive estrangement, the further removed it becomes from people’s own experiences [Fig 1].

Strange Telemetry concluded that they had a reasonably high confidence in their findings, with many of the same themes consistently emerging, unprompted. They did however raise the limitations of



Fig 1. Speculative Design and the Future of an Ageing Population – Future of Work (Swansea) Image 1. Shop (Image by Strange Telemetry).

their workshop element, in that active facilitation is necessary to ensure that everybody in the room actually participates and is able to contribute, whereas in reality some may not be comfortable sharing their opinions in a group environment (Voss, Revell, & Pickard, 2015). In an effort to tackle this issue they have suggested that in future it would be beneficial to hold extended workshops, to encourage participants to create their own narratives around the scenarios, rather than merely critiquing what was presented.

Strange Telemetry see SCD and DF as a worthwhile methodology, but one which needs further refinement “we want to continue prototyping new and inventive research methods able to give us greater purchase on the interface of technology and society; and, in the context of foresight and public engagement, enable a more structured mapping of attitudes, consensus, and dissent” (Strange Telemetry, 2015a).

Whilst the use of SCD & DF is a growing trend for the creation of exhibition pieces, the fact that this primarily takes place in a gallery setting casts doubt on how successful these are at engaging the public and encouraging debate. The strength of this methodology is its ability to ask the difficult questions of society, in this instance the questions are those surrounding social adoption and the consideration of how new technologies can be successfully domesticated. However, for SCD & DF to become a truly useful design tool for foresight studies, further development is required for this novel research method.

4. 3D Printing, a Design Fiction

Had we been intending to follow the Speculative Design method as described by Dunne & Raby, at this point in the process we would have designed and produced our diegetic prototypes, which would then be presented to a public audience in the hope of provoking debate. However, behind closed doors 3D Printing is already being used in an array of industries, with machines of ever-increasing sophistication. Therefore, any number of these devices could be exhibited, yet would be perceived as a ‘science fiction,’ such is the misunderstanding and misinformation surrounding this technology.

We therefore decided that rather than present a series of ‘Domesticated’ industrial machines, we would instead engage with members of the public to discover what people were expecting from this technology, based only on their current understanding of 3D Printing.

The concept was to collect data from participants regarding their expected use for 3D Printing in their future everyday lives, this information would allow us to reverse engineer a device (or series of devices) that would be required to fulfil this task. We therefore required a series of questions that would provide us with answers that alluded to the scale, sophistication and functionality etc. of a device. We would be running two workshops that were exploring the same questions, the results from both of these would be combined to inform our speculative prototypes. Although this approach is somewhat divergent from the recognised method, it allows for the consideration of what this technology will enable the participants to do in the future, “fiction writers produce design fiction to give you a sense of how a technology might feel” (Doctorow, 2016). This also means that there is no requirement for participants to have a detailed understanding of the technology in question.

This notion that the diegetic prototypes would be designed by the very people we were hoping to engage with was also an important part of tackling one of the major criticisms of SCD & DF in that it claims to facilitate public engagement, but all too often is carried out in elite institutions that are inaccessible to the vast majority of those it purports to be engaging.

In order to attract and engage with the largest possible number of participants, we chose to use a speculative scenario method of questioning. A display board was designed [Fig 2], with each quarter representing one of four possible futures.

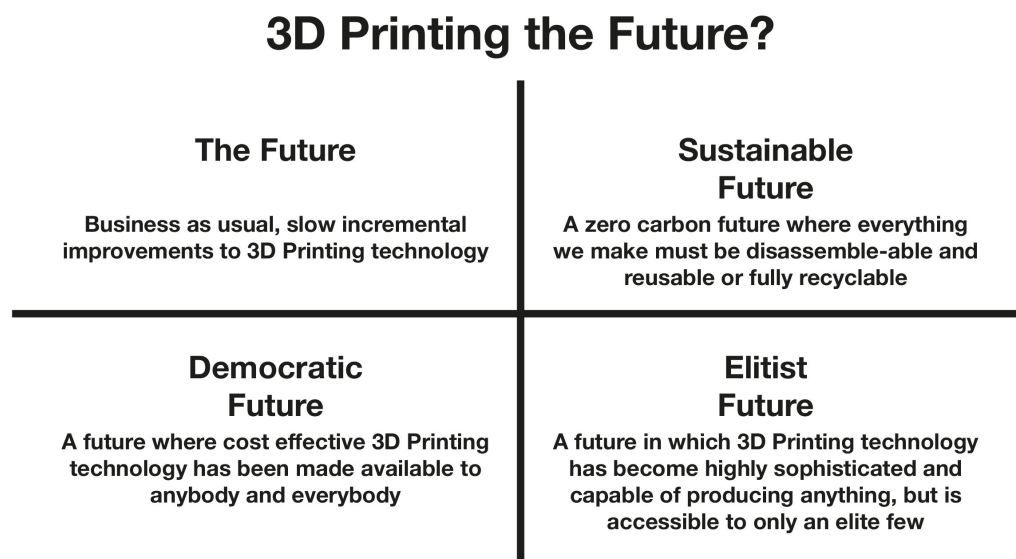


Fig 2. 3D Printing the Future? Workshop— Each of the four speculative future scenarios were accompanied by a brief description (Image by author).

These scenarios were chosen as we felt that they are easily recognisable and relatable without the need for too detailed an explanation. They also have the benefit of aligning with the specific areas of social impact that this research is concerned with, education in 3D Printing, multi-material 3D Printing, eco-effective 3D Printing, and access to advanced 3D Printing.

We then decided on a series of questions that the participants would answer for each of these scenarios. Again, we were conscious of the fact that these should be short, straight forward questions that were easy to relate to. They also needed to be questions that would provide us with suitable responses for describing a 3D Printing device. The five questions were:

(1) What do you think your family would print? (2) What's the biggest thing you would print? (3) What's the most expensive thing you would print? (4) Where would you use a 3D Printer? (5) What materials would you like to print with?

Each participant would be asked to answer the same five questions for each of the scenarios. This would allow us to track how their aspirations for this technology may or may not change based on the different scenarios [Fig 3].

The second workshop we designed had a very different approach. Whilst the first workshop was very much focused on gathering feedback from the largest sample of participants possible, albeit in a relatively quick and light touch manner, the follow up workshop was intended to take a much more in-depth look at what participants were anticipating from the future of 3D Printing technology, with more emphasis on exploring the world-building around their 'speculative devices'.



Fig 3. 3D Printing the Future? Question board – Participants answered the same set of five questions for each of the four scenarios and 'posted' their responses on the board (Image by author).

Each participant was given a set of scenario drivers, similar to those used for the initial workshop, that could be used to help inform a speculative future world. The first step was for each participant to construct their own future scenario, and over a period of 30 minutes they were encouraged to discuss their initial thoughts as a group and further develop their future world. They were then asked to consider the same set of five questions that had been used in the previous workshop, these were used to encourage participants to consider their relationship with this technology in future scenarios.

5. Findings and Critical Discussion

As witnessed in the Scenescene project, we found that common themes emerged across both workshops, unprompted, so too did a number of limitations to our workshops. The entire process was reliant on participant engagement. For the initial workshop, we had 110 participants complete the process; the second workshop had only six, with only two of those able to complete the process. Although the intention for the second workshop was for a small focus group, the fact that this group was further reduced did hinder the sample of results we were able to collect.

We also found that a much greater level of active facilitation was required than had been anticipated. This, alongside comments made by participants immediately following the workshops, highlights the difficulty of asking members of the public who are unfamiliar with design to engage in questioning the future. Therefore, what we had expected to be a rather quick process, especially for the initial workshop, transpired to be a lengthy undertaking for the vast majority of participants, with much discussion between small groups. This highlighted another failure of our method for the initial workshop, in that we had no mechanism with which to record the conversations that occurred whilst the participants were 'world-building', this could have provided us with a valuable insight into what future context they see this technology fitting. There were also a number of lines of questioning from participants that did not necessarily fall under any of the themes we were exploring but were interesting nonetheless, and could have been valuable had we had a means to record them. So, whilst the results confirmed many of our assumptions, they also highlighted the difficulty in asking the correct questions to receive provocative responses.

Whilst discussing his work using participatory design, Simon Bowen uses a quote often attributed to the car manufacturer Henry Ford: "If I had asked people what they wanted, they would have said faster horses." Without knowing the potential for new technology, it is extremely difficult for most people to envision what they would want from it. Emerging technology is almost always going to be outside of their space of possibilities. The task of the designer then is to identify relevant solutions to facilitate participants in imagining their furthest possible future.

The intention of our workshops had been to use the results to inform the design of a diegetic prototype that represented the participants expected future for 3D Printing technology. However, as this technology very much falls outside the participants space of possibilities, what actually resulted was not a series of newly invented devices per se, but more an assembly of pre-existing technologies in a novel manner [Fig 4].

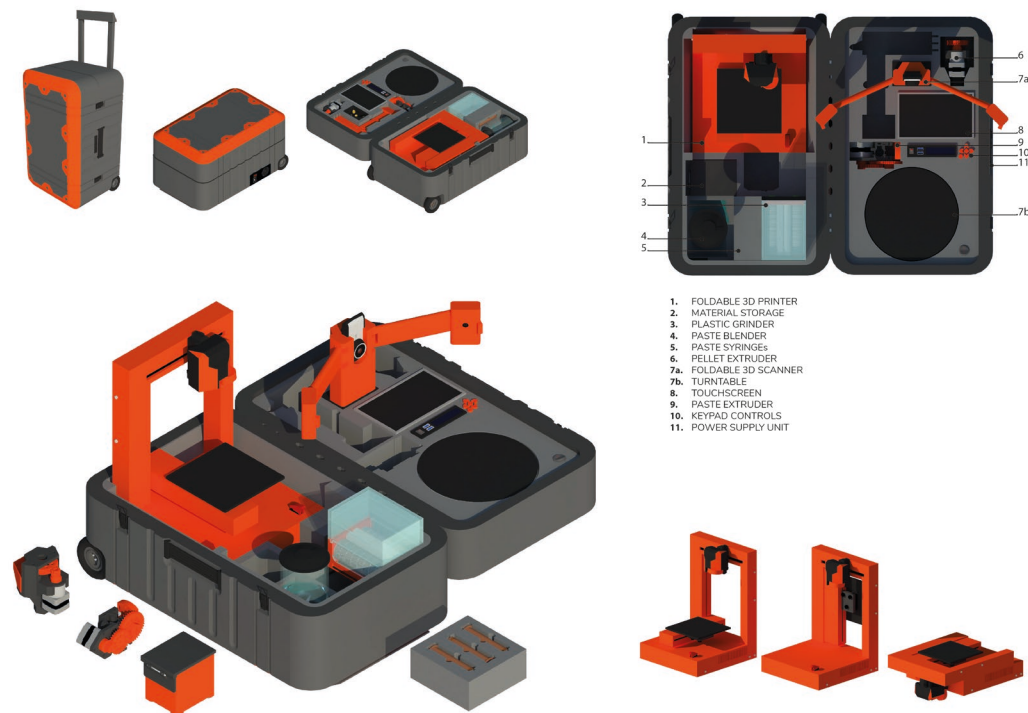


Fig 4. The resultant Diegetic Prototype from the Design Fiction workshops was a portable device that would enable travellers to reproduce or repair items by 3D scanning objects and then print them using a locally sourced/recycled material (Image by author).

6. Conclusion

In this paper we sought to explain the process of SCD & DF and then described a series of workshops that took place ‘in the field,’ to evidence that this can be a useful alternative design method for considering the future development of emerging technology.

We began by explaining the importance of developing new tools for reimagining how the world may be in the future, to enable the design and consideration of more suitable technology. We then described several emerging design methodologies that are seeking to engage the public (end users) in the design process by using science fiction as a way of immersing them in a future vision. Following this we described a number of workshops that have been carried out in the ‘real world,’ that evidence how this approach can be used to collect qualitative evidence for design, policy making and strategic foresight.

Our findings suggest that design fiction is a useful method to engage people and provide them with a platform to question their relationship with technology, with a number of participants having specifically expressed that this novel approach made them think very differently about how they use technology. Whilst the focus of this research is how this methodology can be used to better design emerging technology, it has already been applied outside of the world of design, in fields such as policy planning.

We have made efforts to tackle the criticisms which have been levelled at this research method by carrying out work in the field and engaging with publics, whilst adopting an analytical mode so that our work may be legible to others working in this area. Whilst we have argued that SCD & DF is a worthwhile methodology, it is accepted that it also requires further refinement.

However, this research has also highlighted the difficulty in identifying the correct questions to receive suitably provocative responses. Social design is reliant on the participation and engagement of the general public, those who in all likelihood have not experienced an education in design theory, and as such our research suggests that partaking in an SCD or DF process is a challenging ask. Whilst the vast majority of participants remarked that it was a fun and novel approach, they also noted that it was far more difficult to think about the future of a technology than they had anticipated. In our experience the role of world building is key within this process, as it enables participants to begin thinking outside of their everyday norms. For future workshops we will be exploring how we can better guide participants through this process and experimenting with the resolution of the worlds we help them to create.

The success of this method is reliant on receiving sufficiently provocative responses from participants, this can be problematic as it is difficult to measure the quality or suitability of questions prior to a workshop taking place. The process is also reliant on a high level of participation, which requires a high degree of active facilitation to ensure that all participants are able to contribute. This can be further complicated by unpredictable group dynamics. The role of the designer then is to facilitate participants in imagining their farthest possible future, but to successfully and reliably achieve this we need methods that are better able to address these issues.

Potentially the use of DF and SCD to engage with publics regarding their relationship with emerging technology is hugely beneficial to designers, but at present it is far from being a straight forward process. As there are few recorded examples of this method being used 'in the field', more research is needed in order to evidence how best this can be put into practice. One solution could be a series of guidelines or a toolkit to guide designers and practitioners through workshops that specifically engage with publics. We will be exploring this in future research, testing different workshop designs with the aim of better understanding how to question the interface of technology and society.

If we can be more aware of what publics are expecting from technology in their everyday futures then we can begin to design more appropriately, better enabling emerging technology to achieve its potential. More importantly perhaps, this could also present us with novel and as yet unseen uses for emerging technology, uses which could perhaps offer more potential than their original intended use.

In order to more successfully roadmap the development of new technology we need better tools for predicting possible social impacts. This method of using Design Fiction holds promise for engaging with a broad spectrum of stakeholders, in order to resolve the key social challenges concerning the widespread adoption of new technology.

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