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## Reordering the assemblages of the digital through art and open prototyping

**Citation for published version:**

Hemment, D 2020, 'Reordering the assemblages of the digital through art and open prototyping', *Leonardo*, vol. 53, no. 5. [https://doi.org/10.1162/leon\\_a\\_01861](https://doi.org/10.1162/leon_a_01861)

**Digital Object Identifier (DOI):**

[10.1162/leon\\_a\\_01861](https://doi.org/10.1162/leon_a_01861)

**Link:**

[Link to publication record in Edinburgh Research Explorer](#)

**Document Version:**

Peer reviewed version

**Published In:**

Leonardo

**Publisher Rights Statement:**

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# Reordering the assemblages of the digital through art and open prototyping

Drew Hemment

## **Abstract**

Open prototyping is presented as a conceptual and methodological framework for artistic practice and public participation that bridges the space between technology and society, and contributes to city and technology innovation. The specific concern is with practices which make ideas about the future tangible, and experiment in different configurations of infrastructures, data, situations and people. Many works here are boundary objects, taking place in grey zones between disciplines and sectors. In considering such practices, the paper looks to deepen understanding on the fault lines between art and innovation, and ways in which art can shape the direction of technology development.

## **Acknowledgements**

Thanks to Naho Matsuda, Dan Hett, Peter J. Evans, Saskia Coulson, Joanna Bletcher and all the team at FutureEverything.

## **Reordering the assemblages of the digital through art and open prototyping**

In the present moment, the optimism that once characterised digital culture has long since faded (Pasquale, 2015; Zubof, 2019). As radical gestures are assimilated, artists are testing new strategies, and the search is on for new ways for art to shape reality (Hemment, 2018; Bridle, 2019).

The contemporary landscape of art and technology innovation took shape from the 1960s, when the ideas of Stewart Brand in the Whole Earth Catalogue anticipated the digital era, and the Organisation and Imagination Group (later referred to as the Artist Placement Group) and E.A.T. (Experiments in Art and Technology) pioneered models of collaboration between art, science and technology (Brand, 1968-98; Paul, 2003). Research on art-technology residencies at Xerox Parc and Bell Labs in the 1970s indicates that such interchange can contribute to novel insights and mutual benefits for both art and science (Harris, 1999). From this period the new media art field has emerged as a site of creative experimentation with technology and data, and critical interrogation of the social context and consequences of technology innovation (Wilson, 2001; Gere, 2002; Paul, 2003). The role of curators in this field includes iterative, distributed and participatory ways in which curators 'follow the artists' (Graham and Cook, 2010). Artists in this field sometimes define themselves as an artist-researcher, bringing curiosity and enquiry to ethical or technical problems as the jumping off point to creating new work. Many new media artists are also technologists, and may divide their time between producing artistic work for public presentation, contributing development time to platforms and code libraries on which those works are built, and supporting other artists to implement and develop shared and open resources.

This paper builds on my practice over twenty five years in art and digital culture, in which emerging technologies are interrogated through experiments in art and participation, and access to data practices is democratised in the public domain.<sup>1</sup> Over this time, I have attempted to articulate and formalise the way art can experiment in, make tangible, and reflect on the social and material conditions of a digital society. This, in turn, has led to the development of methods and principles for devising, commissioning, facilitating, producing, evaluating and disseminating such practice. Open prototyping (OP) is presented in this paper as one such effort. It builds on prior curatorial programmes such as Locative Arts and the Data Dimension (Hemment, 2006; 2011) and methodological innovations reported in the FutureEverything Manual (Hemment, 2011). This includes the model of a ‘festival as lab,’ which was developed through reflection on creative experiments for which a festival creates a liminal space between art, science, technology and society (Hemment, 2011, 2014). OP was proposed to conceptualise work spanning art, design and technology innovation while developing a digital cultural festival for the Smart Nation programme and 50th anniversary of Singapore (Hemment, 2015). It was then iterated as part of an artist development and commissioning programme, Fault Lines, and to introduce art to the flagship IoT programmes in the UK and Europe, the CityVerve IoT city demonstrator in Manchester, the European IoT Large Scale Pilots (Hemment, 2017; Girao et al, 2018). This paper grounds the OP framework theoretically and methodologically, and discusses in depth the first art commission in the CityVerve project, *Every Thing Every Time* by Naho Matsuda. This work was developed in the fault lines between art and technology innovation, and was positioned simultaneously as art commission and the first implementation of the primary technology innovation in the IoT demonstrator.

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<sup>1</sup> I am referring principally here to art curation and social innovation within the FutureEverything festival and organisation between 1995 to 2018, and subsequently at Edinburgh Futures Institute.

**Towards open prototyping: digital art after the relational turn.**

Karen Barad (2003) argues bodies and meanings, things in the world and knowledge of them, are produced by practices that are both material and discursive, such as speaking, writing, measuring, calculating and filtering. Discursive practices are specific social and material conditions through which particular meanings and local truths emerge from a dynamic field of possibilities. She shifts the emphasis from representations of reality by the human subject, to practices, doings and actions that produce both the matter and meaning of phenomena. Objective reality is constituted by the reconfiguring and reordering of the world.

Actor-network theory similarly points to the way things, events and affects emerge through the interplay of a network of human and non-human actors (Law, 92). The digital space is made up of many elements, including code, data, algorithms, standards, server farms, telecoms infrastructure, and also, skilled hands, startups, corporations, public bodies, and the various communities and publics who share their interactions online. Things like organisations, devices and conventions emerge through on-going processes of reorganising the resources and relations in networks of varied actors, human and non-human. Here, the types of creative practice that are our concern can be said to put into play new patterned networks or assemblages of people, ideas, things and actions. Creative assemblages come in a variety of shapes and forms, from closed and compact, to open and loose, with outcomes varying accordingly (Wilkie, Gaver, Hemment and Giannachi, 2010).

Barad draws on Niels Bohr, a contemporary of Einstein, to propose an account of *apparatuses* for the production of bodies and meanings, intelligibility and materiality. Things and truths are produced through a specific apparatus, that is, a local set of social and

material conditions. Barad gives the example of light appearing as waves or particles depending on the instrument through which it is viewed. For Bohr the wave or particle is not an entity that pre-exists the observation, but a characteristic of the interplay between light and the apparatus. "The two different apparatuses effect different cuts, that is, draw different distinctions delineating the 'measured object' from the 'measuring instrument' " (Barad: 815).

For our purposes, we might consider as an apparatus an art commission, design study, or technology specification. The concept of the apparatus helps to account for the way works can be art and technology, wave and particle, at once. Single works in this field may on occasion be described variously as a work of art, of design, or of technology.<sup>2</sup> That is to say, they are boundary objects, that can be interpreted differently across the domains they touch, while maintaining an internal coherence and integrity. Such works occupy an indeterminate position that allows them to move and have purchase across different spaces. Not all of the dimensions may be visible at one time. If a work is shown in an art gallery, it may be presented, qua art, as complete unto itself. But in so far as it is also a work of technology, or of social innovation, it has extension in another dimension too. Shifting from one set of conditions to the other – from tech innovation to art, say – can effect a different 'cut', and create a new plane or surface on which objective reality is ordered and observed.

In this light, I propose that a *prototype* is the enactment of an apparatus, both an ordering of reality and a means of observation at the same time. Prototyping is an approach to developing and testing ideas, making ideas tangible, and allowing play to drive the exploration, so new possibilities can emerge untethered to specific constraints of production

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<sup>2</sup> Consider, for example, Critical Engineering as proposed by artists, Julian Oliver, Gordan Savičić and Danja Vasiliev. <https://criticalengineering.org>.

(Lim et al., 2008; Schrage, 2013, 2000). Stappers (2013) proposes that prototyping has moved beyond its traditional roots in product development and has been absorbed by the research community which describes prototyping as a “research instrument” for testing and validating ideas (p.86). Art is not, of course, prototyping. Conversely, we need not limit use of the term ‘prototype’ to a tool to specify a new product, nor an artistic work-in-progress. Insofar as digital media is defined as unstable (Fauconnier and Frommé, 2003), all digital creativity is provisional and incomplete. To that extent, therefore, we can go so far as to say all creative digital practice can be considered a kind of prototyping, especially where that practice tests ideas, or is enacted as an inquiry.

The term ‘open prototyping’ was coined by Bullinger et al (2011) to refer to the use of "external input as well as internal input" when developing prototypes in industrial design. Bullinger’s use accurately reflects the abductive and deductive thinking commonly found in product development. As I first used the term in 2015, and advanced in this paper, the notion of ‘open’ implies the input from the diverse range of publics, and ‘prototyping’ retains its conceptual form, wherein a prototype is a concept which undergoes rigorous scrutiny. OP is inspired by the capacity for art to ask provocative questions, and create compelling experiences and bold visions, concerning technology and the human condition. Heidegger argues in *The Question Concerning Technology* (1977) that "essential reflection upon technology and decisive confrontation with it must happen in a realm that is, on the one hand, akin to the essence of technology and, on the other, fundamentally different from it" (p.19). He continues, "Such a realm is art" (Ibid.).

Open prototyping, then, is the enactment of an apparatus to create a new ordering in the world, or the patterning of an actor-network. In the context of digital culture, it is the



interrogation and ordering of the assemblages of the digital. It typically entails producing and installing an artefact, interface or experience by configuring infrastructures, algorithms, data, narratives and situations. Here, art-design experiments are seen as apparatuses that enact a local determination of things, boundaries and meanings in the world. OP is, on the one hand, a conceptualisation of the way such works produce an intelligibility and ordering in the world. It is, on the other hand, a framework for orchestrating the translation between one set of social, conceptual and material conditions and another.

### **The OP framework: infrastructuring art and technology collaborations**

Since it was introduced in 2015, OP has been iteratively developed as a framework for the delivery and evaluation of creative projects spanning art and technology innovation (Hemment, 2015, 2017).

As proposed in 2015, it describes and formalises an approach to open, collaborative and distributed experiments in digital culture spanning art, design and innovation (Hemment, 2015). OP refers to creative practice spanning art and innovation, and a means of testing and developing a concept or thing with various contributors and communities given agency at various stages of the process (Hemment, 2015). It involves creative experimentation or play, and a culmination in some form of public experience (Ibid.). Central to this is critical questioning of power relationships in, and democratisation of access to, data systems.

Bringing together critical art and technology and/or city development entails the necessity to navigate the fault lines between these domains. OP is conceived to bridge this gap, by offering a process that encourages partners to engage in the development of shared interests and goals that can lead to new insights for all participants, particularly through engagement with various publics and users. OP connects these different cultures through facilitating

artists to make ideas about near futures tangible. As such it entails a brokerage function, that of a cultural facilitator, translating across these different 'languages': i.e. of art, design, activism, business, and technology.

It was further developed in 2017, when six stages were defined as a guide to design, deliver and evaluate such cross-sector collaborations: Scope, Connect, Play, Produce, Display and Interpret (Hemment, Bletcher, Coulson, 2017). One component of the framework is a visual representation, or 'process model' (Figure 1), to frame and represent dimensions of a typical process when an apparatus is enacted. This represents a process to which artist, facilitator or intermediary organisations can refer when applying this way of working. The aim is to infrastructure the enactment of such reorderings across disciplinary and sectoral boundaries.

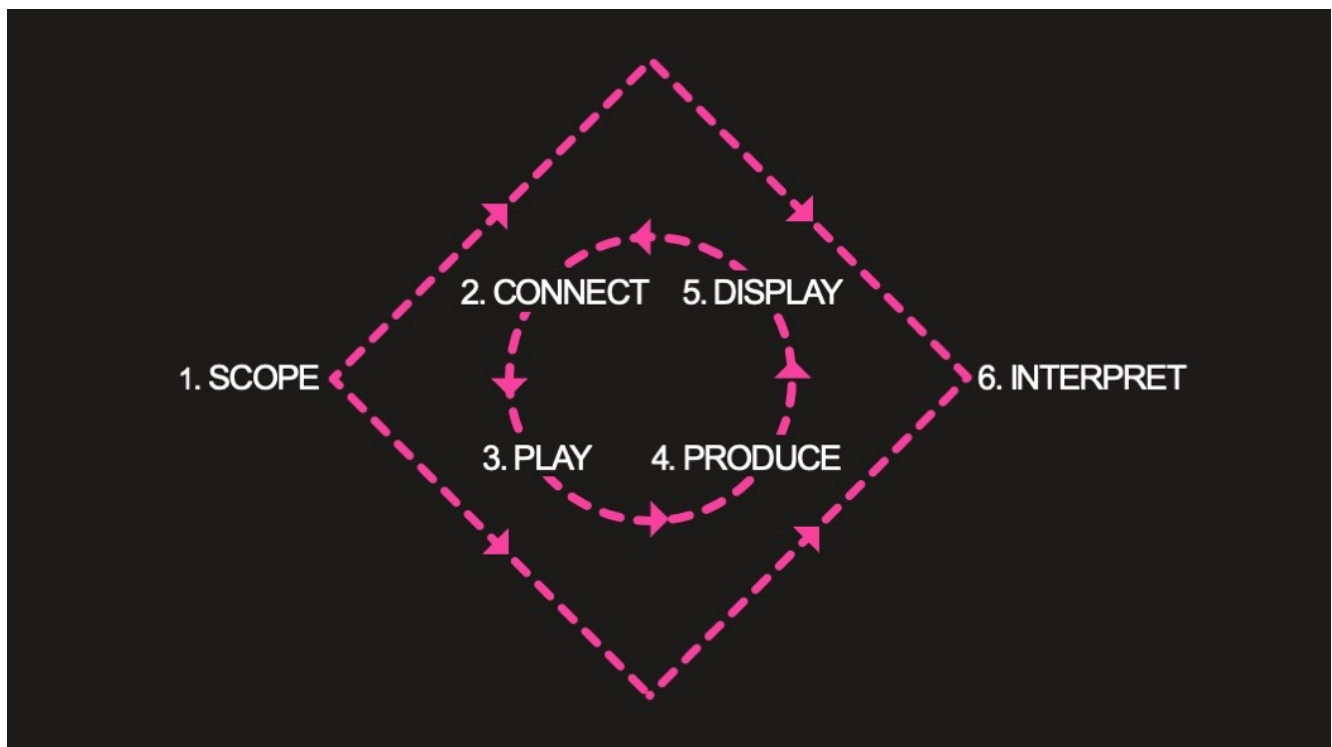


Figure 1: Open Prototyping Process Model V2.0

## **Introducing art to a large-scale IoT demonstrator**

CityVerve was an IoT and Smart City demonstrator aiming to provide an integrative test bed for future IoT applications (InnovateUK, £10M). In CityVerve, a variety of technology innovations were trialled and evaluated. One challenge it addressed is the way that city data is produced via different routes and in various formats by many overlapping services with little or no centralised control. One of the main technology innovations proposed was the CityVerve 'platform of platforms' (PoP).<sup>3</sup> Here, the concept was a "layered, distributed data plane," "with a unified and consistent developer experience" (Rai, 2018). An innovation in project design, which I championed and led, was a pilot for a design method to engage citizens in co-creating the indicators of success for the industrial technology project (Hemment et al., 2016, 2018). Another, the focus of this paper, was the introduction of art as one of the four project themes, alongside energy, health and transport.<sup>4</sup>

OP provided a structure and terminology through which art commissions could be embedded in the proposal, and, later, work plan of the industrial IoT demonstrator. The OP framework was used at various points, including the writing of the proposal, development of artist briefs, and key points of interaction and negotiation between artist and technology partners (1). It enabled the art commissions to be positioned to the various internal and external stakeholders in CityVerve in a way that would have visibility and significance. Crucially, it made it possible to communicate to industrial partners and the principles, structure and pacing of arts practice, its distance to marketing, in terms of intellectual and technical seriousness, and the need for space and autonomy for the artist. The framework inspired a focus on creating spaces for engagement and reflection around the project themes and artist

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<sup>3</sup> CityVerve Platform of Platforms <https://cityverve.org.uk/platform-of-platforms>

<sup>4</sup> CityVerve Culture and Public Realm, Theme lead Drew Hemment <https://cityverve.org.uk/projects/>

commission. Wrap-around activity that built on the artist's research-led process included an artist-led IoT walking tour of the city, a data-poetry workshop, and an artist-technology discussion forum.

The process was not always smooth and seamless. There were challenges in negotiating space and resource for the art commissions in the midst of a large, high profile industrial project under close scrutiny by Government assessors. The artists and curators were acutely aware of the asymmetry of power and resource between a global corporation and cultural workers. There were dissonances when the language and cultures of art and industry rubbed together. The merits of combining art and innovation, and the danger of cultural appropriation, were hotly debated among the curatorial team and with the artists. The negotiations of these concerns became foundational to continued development of the framework in 2017. A separation was introduced between creative play and presentation of artistic work, on the one hand, and evaluation scaffold, on the other, represented by the circle and diamond in the visual process model. During delivery, care was taken the framework and process model did not constrain the artists' creative process. This is a cautionary note when navigating the fault lines of complex, inter-domain projects.

### **The first CityVerve art commission: *Every Thing Every Time***

For the first art commission in the CityVerve project, a call for artist proposals was developed, synthesising the CityVerve project themes, longstanding curatorial interests at FutureEverything, and insights from a series of 'Community Forums'. Artists responding to the call were invited to look at available city data sources, APIs and displays, and explore with technology partners how they might connect an artistic concept to the project themes and technologies. Submissions were assessed by a jury, made up of the CityVerve

technology lead (Cisco), CityVerve culture lead (myself), a city official, and the artistic director of a youth theatre (Contact).

Artist Naho Matsuda was awarded the commission for her artistic concept, *Every Thing Every Time* (ETET):

"This project aims to reevaluate the value of certain data and the meaning of connectivity in the context of the 'connected city'. The project is an automated description of the urban environment in real time, through a written narrative sourced from data, that is stripped from its context and its practical purpose. It is written in a basic syntax and then displayed on screens that are situated in various spaces." Idea #1 - *Every Thing Every Time*, Naho Matsuda

For the jury, a strength in the concept was the way it translated pure data into something more informational, its poeticism and randomness. Also, the way it represents the concept of an entire city being connected, and the introduction of a physicality in the displays otherwise missing from CityVerve. The CityVerve Project Lead, a senior project manager from Cisco, was on the jury, and he articulated the correspondence between the artistic concept and the concept of the PoP. The artist's proposal entailed building on all open city data made available in CityVerve, and hence it was agreed by the artist, curators and technology partner the artwork would make use of the CityVerve API and be conceived as the first implementation of the PoP. Once the work was commissioned, the artist, Cisco global head of APIs, and myself, as curator, used an OP canvas to capture shared interests and goals for the collaboration.

In delivery, Matsuda, with artistic collaborators Dan Hett and Peter J. Evans, developed their own IoT infrastructure to generate over 150,000 unique poems in the first iteration in Manchester in 2017.

the sun rises  
the streets are empty  
today is the last day of the term  
the car park is almost empty  
the traffic light turns green  
the cleaning shift starts  
the bus is on time  
and it is colder than yesterday



Figure 2. *Every Thing Every Time* by Naho Matsuda at Great Exhibition of the North (2018). Produced by FutureEverything. Image © Jack Storey.

The resulting artwork, ETET (Figure 2), has since been exhibited in Manchester as a part of Every Thing Is Connected (2017), Great Exhibition of the North (2018), and South by South West (2019).

### **Configuring reality through cultural prototyping**

In ETET, Matsuda, Hett and Evans devised a novel way of representing city data, and an imaginative interface to the Smart City. Matsuda reports her concern was to create a work that would reveal the truth of smart technologies, what life would be like if everything is connected. In ETET, the city is revealed through data as a dynamic field of possibilities. Meaning is generated in the eye of the beholder through the interplay between the random sequence of short declarative statements generated by the artists' algorithm. This reflects the fragmented reality of a world constructed through the lens of data on things and events in the city.

For Matsuda, a key dimension is the physicality of the work, and the experience of displays installed in situations one would not expect them to be, such as a community garden centre. The lines of automated poetry scroll with a soft clatter across tailored flipdot displays reclaimed from decommissioned buses, on which digital and analogue collide (Figure 3). The artists developed the artwork to re-present city data in ways that invites the audience to discover relevance to their own lives, and connections to the situation in which they encounter the work.

An interest for Matsuda was to give people cause to reflect and ask questions about the information the algorithm generated and the data on which it is based. In developing the



work, the artists looked at the advances in harvesting and retrieving data on which CityVerve built. The artists sought to identify datasets that would create meaning and relevance for people who may encounter the work. One such dataset was prayer times at the city's mosques, alongside other available open data in Manchester. They also created their own dataset generated not by urban data systems but through observations and desk research.



*Figure 3. Flip dot display in Every Thing Every Time by Naho Matsuda at South by South West (2019). Produced by FutureEverything. Image © Naho Matsuda.*



On the opening night, a woman taking a photo looked up to see the statement "the girl takes a photo" scroll across the screen. This poses the question to the audience of whether the statement is based on a real-time observation. It was not. It was fortuitously true when displayed on that screen at that time and place. The artists purposefully inserted data that generates statements that may be true somewhere, but true or false in any particular instance ("the streets are empty"). This class of statement, while credible, is open to question. This weakens the ties between the poems and facts about the world. It deconstructs the presumed unity of data and thing, and, ultimately, of a quantified way of knowing and the world it purports to describe. Matsuda is interested in how this leads people to question if digital information is true and based in fact, and to question the provenance of the data, where it came from, and if it can be trusted. The artistic ambition is to change the way people relate to technology, by introducing a more questioning mindset. This was embraced by the Cisco Project Lead on CityVerve:

"I think this is it. The question. You don't need the answer, just the questions"

(Technology Partner – Cisco).

### **Reordering the *platform of platforms***

For the government sponsor and lead industrial partner, Cisco, the main innovation arising in CityVerve is the PoP. Central to the CityVerve project was the ambition to make accessible all available city data in Manchester through a single access point. From the perspective of the PoP, the city is seen as so many data streams, to be connected and unified, so that products and services can be efficiently produced. The city is what Heidegger would call a

'standing reserve' (Heidegger, 1977) – made up of things and capabilities to access and organise. Under 'surveillance capitalism,' it is us, the people, whose data is captured and acted upon, that are raw material, or standing reserve (Zubof, 2019; Lyon, 2018).

Any digital writing in urban space has to compete with the density of information and signs in the city. Matsuda was inspired to introduce something different and to invite a different interaction to advertising and branding. Central to this is it is non-functional, it is not there to inform, and also that it give cause to question information systems encountered around the city.

Increasingly digital displays push advertising personalised to match the data profiles of the recipients. This assumes a good match between self and data self, and the operations of these systems are neither transparent nor accountable. The artwork represented what was happening in the city, and created a novel way of reading the city through data. At the same time, the artwork highlights the gap or distance between the city and its representation in data. It playfully inserts data designed to be questioned. It foregrounds dissimilarity and randomness in and between statements, and presents data in places one would not expect, unsettling meaning by shifting context. Here, the artwork enables people to observe, and reflect on, the distance between data and data self, information and city. This in turn enables questions to be asked about other unseen dimensions of data systems, such as access, ownership and control, and the decisions that can be based upon our representation in data.

The artwork was seen by the technology partner as a highly effective way to tell people about the PoP concept and underlying platform architecture. What we find, however, is that such works can accomplish something beyond communication of technical capabilities. We

glimpse in such artworks the materiality of data systems, and the underlying play of forces. This can unsettle some of the certainties and assumptions in the way we relate to those data systems. That is to say, it reconfigures the relationship between people, data and systems, and opens a more profound, and enabling, encounter with the IoT. Such art practice can answer Heidegger's call to place science back into the realm of experience, so as to look beyond an instrumental view of technology and understand its essence. Such artworks can serve to both highlight and intervene in the way information on individuals and situations is derived and represented under surveillance capitalism (Zubof, 2019).

### **Navigating fault lines, bridging domains**

During the development of ETET in Manchester, the artwork and PoP became uncoupled as their respective timelines diverged. There were delays in the wider CityVerve project, impacting on delivery of the PoP, and the availability of data for the art commission. Resource and effort were prioritised towards the main technology innovation in the industrial demonstrator, and consequently the artists lost access to technical support from the API team.

The show did go on. The artists developed their own data infrastructure and adopted a modular approach to aggregating datasets that were used to generate over 150,000 unique poems in the first iteration in Manchester. This reflected well on the artists', who were able to deliver an operational interface to the original schedule, in a way the wider project could not.

ETET was in many ways a pressure test, throwing artists and curators from FutureEverything together with technology industry project managers. The way in which the artwork and PoP became uncoupled reveals the limit in the strength of the pipeline. A crack appeared,

puncturing the shared commitment needed to sustain the constellation of actors and effort. This reminds us the relationships need to be continually 'performed' (Latour, 2005). It also highlights the asymmetry in resource and influence in the industrial demonstrator project. At the end of the day, the industrial project was measured by the Government funder against economic indicators, and the underlying material conditions remained essentially unchanged.

To bring change to the technology industry, it is necessary to challenge the more corrosive impacts of data technologies, and to establish new directions for technology development. For this, it is necessary to engage in the underlying science, and to challenge the primacy of quantification and correlation. This can provide the foundation for work that shapes new paradigms and thinking on technology and its place in society.

It is also necessary to go beyond project level, or the level of individual participants, to engage in policy, and to shape the funding calls and criteria. To have influence over the direction of technology development, the art practice needs to reach beyond existing cultural audiences for such work, to engage industry professionals, funding agencies, politicians, and the officials charged to deliver infrastructure as well as social goals. Introducing art to industrial technology innovation projects introduces significant new audiences for critical media art. The value the industrial and city partners, citizens and other stakeholders, perceive in these projects is critical.

The project manager of a large technology demonstrator might be expected to foreground certainties in the project over which they have control and jurisdiction. Through their participation in this artwork, there was a shift from certainty to uncertainty, from solution to question. They have moreover promoted a central role for art, and a questioning mindset, in

future technology demonstrators. The artistic work and its distancing from instrumentality introduced a cut in the corporate technology innovation space, and a new set of coordinates against which the objectives and outcomes of this and future projects can be assessed.

## **Conclusion**

OP provides a set of principles and tools for delivering and evaluating innovation through artistic creativity and participation. In the IoT city demonstrator, the artwork (ETET) and IoT innovation (PoP) were two apparatuses for ordering infrastructures, data, situations and people. From the perspective of OP, each enacts a local determination of things, boundaries and meanings in the world. Each one embodies a distinct set of assumptions, and power relationships, and can produce distinct readings and pathways for future technology development.

The role of OP can be to challenge us to be bold about the art of the possible, and to reframe the questions and suggest new directions for technology development. Here, the ability of art to interrogate complex ethical questions alongside the technical is significant. OP can help to facilitate this, and also play a vital role here in evidencing and communicating the benefits of such work. The positive reception among the industry partner, and the value they articulated, provides powerful evidence that these connections are possible.

Art practice in technology innovation could easily be objectified as spectacle, recuperated, and degraded from critique to marketing. But it can also break open the veneer of the black box, interrogate the ethics of data systems, and present novel concepts for the governance of these systems. ETET created a configuration of people, algorithms, data and display that foregrounds serendipity, curiosity and delight. OP provides a scaffold for eliciting insights

during the development or reception of the work. Our evaluation revealed the OP approach can help to generate transparency, legibility and literacy around the concepts and technologies. At the same time, this art practice and the resulting work stimulated a critical, questioning engagement in city data systems, among the general public, artists, as well as employees at the technology company, and stands as a case for ordering the Smart City in ways other than solely maximising extraction of economic value.

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