Engagements [2] as 'HCI Material': Propagating Community Agency, Through Embedded Technologies

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HCI has material attributes. As a sociotechnical assemblage, HCI mediates and/or translates technologies to public(s) and vice versa. It is malleable, 'made' and crafted and as a material media technology changes our relationships to 'things', each other and our surrounding world. Thinking through HCI as material allows us to unite disciplines with technologies, ensuring that how we conceptualise work is tangible and applicable. Working from this understanding of HCI, allows the authors to contextualise Engagements [2] as an emerging 'material' space uniting art, design and other practices often fractured through disciplinary conventions. Traditionally, public engagement encompasses ways organisations engage with external parties. HCI contemporaries, Public Interest Technologies (PITs) empower public stakeholders and municipalities. PITs unravel intractable problems, through design, data, and delivery, thus providing user agency and yields wider societal benefit(s).

We question how digital technologies can transition 'public(s)', to sustainable approaches. In time, Engagements [2] will be commonplace as technologies (PITs, augmented reality, IoT sensing and more) are embedded into public environment(s) if engagement can be defined as a 'craft-able', material concern. The article unites contemporaries in the public realm, social design, and public engagement methods to identify the: pitfalls, benefits, and opportunities. There is a need for creating a 'best practice' roadmap to creative, active engagement. These values go well beyond designing for inclusion and seek for more sustainable and integral interactions, impacts and culture creation.

Keywords: Engagement, Creative Practice, Human Computer Interaction.

1 Research Objective(s)

Opening a creative space beyond 'participation', comprehending Engagements[2] as an HCI material. Answering: *How should carefully curated 'Engagements[2]' form new embedded practice(s), transitioning sustainable actions, through HCI?*

1.1 Introduction

In the past decade, 'engagement' has become an increasingly expected – and often measured – aspect of research practice in multiple national and disciplinary contexts. REF [two sentences here that elaborate on this, with references. then a sentence on 'engagement' within HCI, and on 'engagement' within design and art research, with references.] Despite the growing literature and body of practice on research engagement, widely and within HCI, art and design, the concept remains unstable and is subject to interpretive flexibility depending on the context. Put simply, 'engagement' means different things to different people. [REF] Furthermore, 'engagement' can range from [first order dissemination/communication to communities] to [third order integrally interrelated, contributive, in which engagement upstream in the research process shapes research questions and objectives] [REF]. Public engagement is often seen as a 'bolt-on', a dissemination activity, passive and not commonly an active process. Many approaches have included 'the public' in art and design disciplines. One exemplar is Open Design (OD). OD encompasses "on-and offline design and making activities, describ[ing] a design process allowing for the participation of anybody (novice or professional) in the collaborative development of something" [4]. OD enables design to move beyond professional realms as designing *"has to be made present as an activity that extends well beyond the rubric of designers"* [5]. In contrast, engagement can enable participants to transition beyond consequence mitigation to active activities. This model for engagement is gaining increasing traction amongst research stakeholders including funding bodies. In Britain, UK Research, and Innovation (UKRI) states that "research and innovation should be responsive to the knowledge, priorities, values of society and open to participation from all backgrounds" [6]. Authors of a 2020 report by UKRI highlight two concerns: "[to] nurture a future generation passionate about research and innovation" and, "[to] listen to public concerns and aspirations" [7]. Aligned with this third order expectation for the possibilities of engagement, we propose a model of engagement. Authors propose our treatment of engagement should be inclusive, respectful, and ethical. As funding bodies, reviewers, hiring, tenure and promotion committees, clients and wider publics alike in many national and disciplinary contexts increasingly expect research not only to demonstrate social, environmental and economic value to communities but to engage and engage with communities within the research process, not only defining 'engagement' but understanding its valences and possibilities becomes increasingly important. This paper adds to the literature setting out best practice for engagement in HCI, design and art research through the proposition of Engagements [2] as a conceptual approach for undertaking research with civic and environmental value. By Engagements [2], we understand an emerging 'material' space that unites art, design, and other practices through [what] [to do what].

The paper substantiates and articulates Engagements [2] as a social or community technology for this purpose. Authors see 'technologies' as having the potential to support civic empowerment, enabling and catalysing citizens. Citizenship advocate Hess defines 'Community Technology' *{1}* as resources "enabl[ing] scientists, engineers, and craftspeople to re-think the roles of their skills and talents, to become part of everyday life" [8]. Hess summarises the "need to shift from focusing on single issues, toward taking holistic approaches" [9]. Authors propose the concept of Engagements [2] as transdisciplinary materials that provide people with agency beyond HCI experiences. The article reports on interdisciplinary literature, key stakeholder interviews, analysis, and expert symposium findings. The article frames pitfalls, benefits, and opportunities to the combined territory. Engagement approaches need to be embedded within communities as we look to: deployable, repairable, and more citizen-led technological HCI. Authors frame the HCI, design and arts space, share lessons from leading practitioners and then translate insights that can be applied to HCI contexts for deeper active engagement of audiences. *Engagements [2] as 'HCI Material'* guides readers through literature, projects, lessons, and analysed insights for repeatability and scalability. It is valuable to territories overlapping HCI, design and arts-based communities; intent on tackling contemporary sustainable issues.

1.2   Material Engagements as Political Acts

Both HCI and Design (as a practice) communicate making interactions usable and tangible. However, some methods or approaches allow researchers and practitioners to move beyond dissemination for more meaningful engagement upstream with communities of interest. The argument in this paper derives in part from the authors' shared commitments to careful, critical art, design, and creative practice for social good, with awareness of the power relations at play in any such claim. Within this commitment lies an understanding that design can generate agency for both those that produce it and those that use it; it is a tool which is being used as a pervasive means to address issues of our time. 'Good' design is often engaging utilising design to engage and captivate viewers and users; using aesthetics, technology, materiality and meaning to stimulate social interactions; and providing compelling experiences. Creative practitioners use the powerful language and culture of objects, technologies and products and the potency of services and systems to change behaviour, provoke protests and empower communities as well as to develop consumer material and visual literacy. Designers *"have become more engaged as citizens and more conscious of the roles they play in culture, politics and society, both serving and creating"* [10]. Art's function is a contested subject. Rivalries exist between those that believe it is art's autonomy that generates its agency - thus providing an ability to maintain a distance from society to challenge it; and those that want to utilise it to deliver a different type of society (Arte Util). Others are committed to its expressive, formal, and decorative qualities [11]. Creative cultures reflect upon social problems and can intervene and act on the world through changing the way things are and producing new futures and imaginaries. Art's relationship to its audiences and users are based on a different type of encounter to designed products and systems, although what both art and design practices have in common is the ability to work on the world through actualising ideas and presenting new alternatives to existing problems. As we

transition to what we will call a creative approach to living where travel, health, food, materials, and interactions with the natural world will require greater political, economic, and ecological transparency. Authors believe that 'engagement' is a definable commodity and material force to enact sustainable transitions and to develop a new paradigm of Arts and Design Practice; to this end the numerous versions of how we might engage with things and others deserve to be explored. The intention highlights the need for producing art & design research with appropriate communities whilst acknowledging the criticality of publicly embedded outputs, enacting change, and producing *impactful alternatives*. Examples of pervasive technologies (being disruptive) include online shopping [12], Arduino *{7}* [13] and IoT monitoring without data safeguards [14].

As technologies become more pervasive, Public IoT, accessibility, cost, proliferation of smartphones, drones now publicly owned, these routes to engagement will become more possible. A second commitment shared by authors concerns the politics of agency. Authors believe in providing agency to groups, as a form of democratic empowerment. Citizen *"engagement is not only a basic element of democratic systems, but it is also crucial for other elements of democratic systems"* [15] and is written into statutory processes, for example in the UK's 'neighbourhood planning' mechanism, which gives communities more involvement in decisions around local development strategies. A lack of tools and processes for engagement processes can hinder people's capacity to engage in visioning processes [16], [17] & [18]. The Creative Citizens project {8} co-designed participatory technology with community groups, including the use of digital maps that enable comment threads around specific issues and locations, to gather wider local engagement with the development of neighbourhood planning proposals [19]. Public "disengagement with democracy can provide fertile ground for populism", i.e., a broader concept such as 'designed engagements can enable democratic participation, to explore new, rich territories' [20]. Citizens have a major role to play in addressing the challenges to a sustainable future. For example, 'Doing It Together' Science (DITOs) "implements many innovative participatory events across Europe focusing on the active involvement of citizens in two critical areas: the cutting-edge topic of bio design and the pressing area of environmental monitoring" [21].

Whilst there are challenges for how we engage the natural world, there are also challenges in how we engage each other within it. To achieve active Engagements [2] with the public and stakeholders, we are compelled to design for humans and communities, not scenarios and personas. Designing "products to support users' behaviour change is becoming one of the most popular trends in design research at the moment. To achieve the desired results, design for behaviour change, and in particular, Design for Sustainable Behaviour exploits a variety of approaches" [22]. [whilst behaviour change is one potential impact of engagements within these civics and sustainable? space, Engagements [2] has broader intent. It aims to provide communities with....], as this practice is intent on providing communities with agency and empowerment through art and design interventions, in effect as a form of 'citizenship'. Prior author work has discussed "ecological citizenship" and questioned our role within sustainable society, giving people agency over their environment [23]. A third commitment concerns material practice. *Public Interest Technologies* (PITs)

empower public stakeholders and municipalities. PITs unravel intractable problems, through design, data, and delivery, thus providing user agency and yielding wider societal benefit(s). Authors question how digital technologies can transition 'public(s)', to 'sustainable approaches'. Current challenges and opportunities include: material consumption; climate change; circular economies and product life extension; ecological citizenship (citizens benefiting local ecologies / environments); re-naturing and transitioning to more sustainable behaviours. Engagements [2] can create and foster similar longevity to that of the longevity of conventional material infrastructure and its smart form, including emergent PITs. Mechanisms for Engagements [2] require rethinking; the materials are not solely 'digital' or wood, metal, plastic etc. They are embedded; systems, ticket machines, cultural institutions, digital bus stop signage, maker spaces, distributed materials, off-the-shelf parts, builders' merchants, community spaces, vending machines, recycle stores, service station leaflet displays, accessible resources, local non-government organisations, community resources, downloadable plans, broadcasters, social media, WhatsApp groups, radio stations, tear, and share signs etc… and digital resources. Engagements [2], operates beyond participation, as a deployable material for mutual citizen, community, and practitioner gain [24]. Engagements can be designed, are designable and can be co-defined and sculpted (with adequate creative consideration) to stimulate and foster collaborative envisioning, consensus building, creative co-operation, and community cohesion [25].

Figure 1 is a visual map communicating how authors frame example projects, with numbers e.g. *{x}* providing cross referencing. Practice exemplars demonstrate the authors' conceptual framework of Engagements [2]. Design practitioners *Blast Theory {2}*, leverage various technologies for active participation [26]. Their project *I'd hide you* is an example of real world public IoT games, authors see the 'product' as the engagement [27]. Virtual reality is now used on cruise ships to sell diving experiences of far flung and or inaccessible spaces to amateur divers *{3}* [28]. Sensor networks that were once under the ownership of municipalities and councils are now established by amateur, even created through DIY kits and processing power, for example the *smart citizen's {4}* project [29]. Quitmeyers' Digital Naturalist *{5}*, creates engagements with leading ecologists, fabricating custom technologies live within the amazon basin, transforming expert's capabilities [30]. Finally, the pandemic shift saw institutions offering digital experiences whilst their buildings remained inaccessible. Authors see this territory as creating custodians of sustainable interventions and preparing the field of HCI to build on it appropriately and ethically. In *Design as Politics,* Fry presents a rigorous review of transitioning beyond dichotomies of sustainable practice, to 'sustainment' i.e., embedding adjustments within community life [31]. The challenge is 'instilling agency' and designing engagement(s), to achieve embedded buy-in from participants, creating empowered citizens and custodians, rather than traditional HCI 'users'. Authors frame an 'engagement space' (through HCI) enabling participants to become empowered and direct the use of technology within their lives. One contextual example is a 'technologically enabled' rock pooling net used by amateur/expert stakeholders. The net could explore and feedback details on water quality, biodiversity, lichen etc. The net could be borrowed from a tourist office, wildlife trust etc. The nets gathered data can be used at source, to invoke public experiences. Employing these pervasive

technologies within the frame of Engagements [2] can catalyse a more informed public and transform our actions to more sustainable approaches.

1.3 Defining Active Engagement

A grounded example of Engaging Design (ED) is *The Nursery Garden* {29}, a collaborative public artwork by SUPERFLEX. Designed for three public hospitals in the French islands of Réunion and Mayotte located in the Indian Ocean. Nursery Garden facilitates knowledge exchange between medicine cultures, challenging boundaries of 'modern' and 'traditional' medicine. "Each hospital courtyard, [hosts a] plant nursery and surrounding garden, containing medicinal plants growing on each island. The nursery gardens provide a neutral setting where patients, visitors and hospital staff can take a break, meet each other, learn about botany, join a workshop, or nurture the growing plants. As the plants grow larger, they are replanted onto the outer hospital grounds" [31]. As plants are grown and archived, local culture and knowledge of the medicinal plants is maintained for future generations. The project goes well beyond 'participatory' models and cultivates new roles, new communities, educational value, and new relationships, both inside and outside the hospital. Authors question what happens when we employ engagement methods and techniques, as part of an explicit process of art and design practice and what types of engagement(s) generate productive results? Engagements have different scales and levels of engagement from DIY movements and people creating their own technologies, through to garden observation. During the collaborative *'My Naturewatch' {9}* project between Goldsmiths Interaction Research Studio and the Design Products Programme at the RCA, the design research element became the notion of 'citizenship' that was produced when participants engaged in the collective event of using technology and watching nature. The emphasis on citizenship and community provided a more comprehensive involvement transcending the technical use of a camera and establishing a community of interest. The *My Naturewatch* work identified a new potential in engagement providing citizen authorship and transformation [32]. This 'Engagements [2] agenda' will be a trajectory for the blending of disciplines enacting change and can be used to transition to sustainable means. Engaging Design: "showcases creative material, models and methods for transformative action. Sustainability is arguably a human construct born from a necessity to re-engage with our relationship to a range of issues" associated with our biosphere dependency [33]. Active Engagement Definition: when are facilitated to become actively engaged in a product, service, social issue, through an interaction that can provide solutions to themselves and other physical or digital communities.

1.4 Design-led Frame

In *Research into Art and Design*, Frayling identifies three approaches: Research into Design, Research for Art, and Design and Research Through Design [34]. Our agenda falls into Research Through Design as the process of including stakeholders and communities can often yield interesting and unpredictable results. The act of including people within the design process is traditionally Human Centred Design. This has taken many forms: Participatory Design; Co-design; User Centred Design

and more, each having unique subtleties and nuances. Authors see a point of difference, is that Engagements [2] is 'intent on actively engaging audiences' informing their agency. The emergence of *Society Centred Design* forms principles: *Design for sustainable development, Confront uncertainty* and more *(societycentered.design).* As a discipline Planet Centred Design refocuses our attentions.

> "Our planet is threatened by human activity, propagating a human centric worldview is no longer adequate. Agency in design becomes ever more important, to include secondary users, affected bystanders or non-users, or non-human beings affected by design interventions" [35].

Sevaldson highlights 'systems thinking' approaches to proposed solutions and overtime builds resilience by using discursive methods. We need to surpass Human Centred design principles and centre ourselves around the environment, the wildlife, materials, impact etc. The Engagements [2] approach values serendipity through engagement, building a research through design approach. Design should "do less harm to leaving things better" [36]. Thackara endorses the 'art of hosting' and reciprocity:

> *"Empower[ing] local people:* any design action that rearranges places and relationships is an exercise of power. A good test for sensitivity of a design proposal is whether it enables people to increase control over their own territory and resources [i.e., reciprocity]. The principle of reciprocity: anyone who takes from the commons has to contribute [to] the commons" [37].

In totality, Thackara sees grassroots and bottom-up opportunities as a form of citizenship and form of human rights, which is the material language of Engagement. These two principles are paramount as they proliferate agency and a notion of collaboration, no matter how small. We "must end this obsession with perpetual growth, change is most likely to happen when people reconnect – with each other, and with the biosphere – in rich, real-world contexts" [38]. We are living at a time of transition from Human to Planet centred design and engage communities within that challenge. We still need to understand challenges within context by and for communities, whilst moving beyond sustainability to empower sustainment. Design practices are converging dictated by materials, track record and expertise not just by someone's training:

"Research Engagement as Activity: understood as an activity, initiative or event.
Research Engagement as System: unfolds through a more complex set of relationships between people, things, and places.
Research Engagement as Relationship: the idea of a relationship between two parties.
Research Engagement as Process: linear or cyclical processes of research or knowledge-to-action.
Research Engagement as Affect: A final configuration" [39].

1.5   Design-led Field Exemplars

Engagement as Activity: *an activity, initiative, or event. Virtual Snorkelling {3};* allows water parks to transform any pool into a vibrant attraction allowing guests a full-body sensory experience through coral reefs, shipwrecks, and underwater caves

in exotic locations. Guests "swim alongside turtles, manta rays and massive whales seeing a world previously accessible to advanced scuba divers in remote international dive spots" [40]. *The Urban Barley Field* [41] *{10};* Estonian design/agricultural installation, encouraged locals to change their neighbourhood. The grassroots crowdfunded project was built and cut by volunteers. Harvested crops were gifted to funders; with some laboratory tested, calculating the area's pollution levels. The "project inspired locals and authorities to enliven the traffic channel with 38 flowerbeds" [42]. The impacts were encouraging local government into funding pilots for urban food in the area. The *Crochet Coral Reef {11} (crochetcoralreef.org)* responds to climate change. It is an exercise in applied mathematics, and a woolly experiment in evolutionary theory. *"Living reefs are dying from heat exhaustion and awash in plastic, the Crochet Coral Reef offers an impassioned response.*
The Reef project is a condensation of human labor, hundreds of thousands of hours of stitching quietly performed" [43]. *Crochet Coral Reef* contributes to Engagements [2] as it creates a direct link between people, scientific materials, the act of making and textile materials. Encouraging the creation of artefacts, spaces, and public exhibits that all can engage with.

Engagement as System: *complex relationships between people, institutions, ideas, places etc. Living Sea Wall {12};* manufactured structures mimicking the root structure of native mangrove trees, the Living Seawall adds complexity to existing structures providing a habitat for marine life. Aiding *"biodiversity and attracts filter-feeding organisms that actually absorb and filter out pollutants – such as particulate matter and heavy metals – keeping the water 'clean"* [44]. *30 Days Wild {13};* Annually in June, thousands of people participate in the Wildlife Trusts nature challenge, 30 Days Wild. By participating in one *"wild thing a day throughout the whole month: for your health, wellbeing and for the planet in 30 simple, fun and exciting Random Acts of Wildness"* [45]. These examples are tied into specific locations, times, networks and are interconnected by stakeholders, interdependencies, and systems.

Engagement as Relationship: the idea of a relationship between two parties.
The 'Crime Prevention' Occasional Badge {14}; produced by West Yorkshire Police and the University of Huddersfield. It "engage[s], educate[s] and empower[s] Cub [scouts] in relation to the importance of crime prevention, specifically the prevention of domestic burglary and online safety" [46]. The project formed a positive relationship within an existing context leveraging the desire to obtain recognition and working with a local constabulary, i.e., engaging relationships with communities.
Public Lab Balloon mapping {15}; Balloon mapping is a low-cost way to take aerial photos using a camera, attached to a balloon, on a spool of string "from a few hundred feet up all the way to over 4,000 feet in the air" [47]. Both examples form a link between users, makers, communities and collected data, the relationship becomes intertwined relying on all parties. Both examples contribute toward 'Engagement as Material' as they both form a relationship between communities, methods and people's homes.

Engagement as Process: processes of research or knowledge-to-action. *Zooniverse {16};* a citizen science platform that enables everyone to take part in real cutting-edge research in many fields across the sciences, humanities, and more. The Zooniverse

creates opportunities for you to unlock answers and contribute to real discoveries [48]. These projects provide a two-way framework and process between initiatives and communities, providing a voice to disparate and underfunded communities. Creative Citizens {8} co-designed digital tools with community-led projects for the projects to use as part of their own processes of engaging wider participation. Participatory civic technology was used within neighbourhood planning, whilst digital media tools were included within the aesthetics and activities of a community centre, to develop storytelling about the space. These digital engagements sought to boost participation, capture value, and increase belonging [49]. These examples open a dialogue between parties, within a tight process that transfers knowledge-to-action.

Engagement as Affect: A final configuration. The My Naturewatch (NW) project *{9}*, is "[an] inexpensive wildlife camera designed for people to make themselves promoting engagement with nature and digital making. It aligned to the interests of the BBC's Natural History Unit. Since June 2018, the BBC featured the camera on a SpringWatch broadcast, over 2,500 [at time of writing] NW Cameras are constructed using instructions, software and commercially available components" [50]. NW enabled participants grow beyond the original intention providing serendipity to research. NW can provide unity across communities and be adapted by novice or expert. It contributes to Engagements [2] by going beyond participation, is open to public response, enables others to build their own resource at rapidly diminished economic cost.

1.6   Art-led Frame

Practice-led research in art is conducted primarily through the medium of practice. It is situated at the confluence of practice, theory and history and requires that the practitioner-researcher is fluent in all these fields [51]. As a scientist turned creative practitioner, Skains notes, 'that artist researchers offer insights into art and the practice of art as it occurs, but can throw new and unexpected light onto a range of topics including cognition, discourse, psychology, history, culture, and sociology' [52]. The artist-researcher seeks to understand things in the world through action and reflection. A rationale for the production of an artwork which reflects the site, context, theory, and previous practices is established, the researcher works towards to final outcomes by adapting their ideas and responding to any insights or new knowledge they acquire on the way [53]. The means by which the artefact is realised, and its content is developed together by the researcher, thus the outcome is not usually illustrative of the content and process [54]. Although contemporary art has embraced participatory methods as a form of social art practice, seeking contributions towards shared authorship as a way of overturning the canonical artist. Some artist - researchers use participation as a part of collaborative processes seeing contemporary art as a form of opinion formation rather than a way to enact public engagement [55]. Whilst artists do not consider their audiences as users as is the case of design, they do share social and community principles. "Socially Engaged Art Practice" [56] shares an ethos with Socially Centred Design as outlined above and many would also align with what Thackara has described as "Empowering Local People" [57]. The author's approach to Engagement as Material correlates to the theories of civic engagement. Vaughan and Jacquez [58] note that the Spectrum of Public Participation describes a

continuum of engagement. The 'inform' phase provides information to help communities relate to complex topics, this leads to 'empower', in which decisions made by participants are implemented into practice. One outcome of Engagement [2] is to aid the formation and communication of participants' own opinions through engaging in affective and aesthetic processes of knowledge acquisition [59]. This positions art and design engagement as research through the process of hypothesis, testing and reflection in collaboration.

1.7   Art-led Field Exemplars

Engagement as Commoning: care and sharing for an egalitarian society. The art collective, SUPERFLEX, inquired into the problems of power, both through the way in which global capital operates and in relation to high culture [60]. For example, their project 'Free Sol Lewitt {17}', for the Van Abbemuseum, in 2010, saw them set up a metal workshop to produce copies of a work by Sol Lewitt, Untitled {18} (Wall Structure), 1972. Replicas of the artwork were made and then 'set free', given away to the museum's public, free of charge. This sharing of cultural artefacts becomes a type of intellectual property commoning [61], which not only extends Sol Lewitt's ideas of reproduction – he specified artworks and others produced them – but emphasises the shared ownership of objects held in museum collections. SUPERFLEX member, Christiane Berndes, says, '[i]f the museum's role is to collect and preserve artworks then maybe the next step is for it to distribute artworks, to open up new levels of use, access and ownership' [62]. Their approach offers 'propositions' to ingrained problems rather than overturning the condition of the problem. Moreover, their projects have consistently utilized design and engineering processes to produce responses to social problems typically developing new systems over single products. For example, the Supergas project {19} in which they developed a biogas energy production system developed with European and African engineers. 'Supergas is a simple biogas unit that can produce sufficient gas for the cooking and lighting needs of a typical family living in rural areas of the Global South' [63]. The 'care' in their work is demonstrated by the way in which they produce tools to engage critically with systems of 'social and cultural production and distribution, with financial and political institutions, with the law, with renewable energy and with urban space' [64].

Engagement as activity: At its most basic, research engagement is understood as an activity, initiative, or event. *On Space Time* {20} is a floating structure composed of three levels of clear film accessible to the public, inspired by the cubical configuration of the occupying exhibition space. The work is a giant instrument with movement creating reverberations and acoustics [65]. *Trolley Reef* {21} is a long-term project and artwork creating a new oyster reef in North Kent, using supermarket trolleys. The idea plays with the common sight of seeing the legs of dumped trolleys sticking out of waterways, a symbol of society's disconnect and disregard for nature. Supermarket trolleys are also the end point of an industrial and global agricultural system that is destroying ecosystems worldwide. The trolleys will be used in the same way as the traditional *oyster culture* cages which grow new reefs, holding the oysters while they grow [66] and will be passed over to teenage custodians to benefit from over time.

Engagement as system: Engagement unfolds through a more complex set of relationships between people, institutions, things, ideas, and localities. *Project Row Houses* {22} site encompasses 39 structures and is home to community enriching initiatives, art programs, and neighbourhood development activities. PRH programs touch the lives of under-resourced neighbours, young single mothers, small enterprises, and artists interested in enriching people's lives [67].

Engagement as relationship: Probably the most common manifestation of engagement in the literature is the idea of a relationship between two parties. *Chicken Town* {23}, Assemble worked with Chicken Town to create a not-for-profit social-enterprise restaurant serving healthy fried chicken to Tottenham [68]. In *A designer's approach how can autistic adults with learning disabilities be involved in the design process?* creating activities for engagement was paramount in building trust and creating meaningful connections between the designer and autistic participants [69].

Engagement as process: Linear or cyclical processes of research or knowledge-to-action. *Climavore: On Tidal Zones {24}.* Humans eating can Change Climates. CLIMAVORE is a long-term project that sets out to envision seasons of food production and consumption that react to man-induced climatic events and landscape alterations. The project engaged with local restaurants that removed farmed salmon off their menu and introduced a CLIMAVORE dish instead. CLIMAVORE reviews forms of eating, addressing environmental regeneration and promotes more responsive aqua-cultures in an era of man-induced environmental transformations [70]. *Feast on the Bridge {25}* for one Saturday each September Southwark Bridge (London) was closed to traffic for an urban harvest meal enjoyed by over 35,000 people. The project's emphasis wasn't on spectacle, or even entertainment, it was simply to explore the cyclical story of food production, reclaim the space from traffic and invite people to engage, sharing food and conversation [71].

Engagement as affect: A final configuration. The *Tele-present Wind {26}, when* the wind blows it causes the stalk outside to sway. The accelerometer detects this movement transmitting the motion to the grouping of devices in the gallery. Therefore, the stalks in the gallery space move in real-time and in unison based on the movement of the wind outside [72]. *For Forest {27}* unifies the 'unending attraction of nature', a temporary art intervention that transformed the Wörthersee football stadium in Klagenfurt into Austria's largest public art installation in 2019. Around 300 trees, some weighing up to six tons each, were carefully transplanted over the existing football pitch to give the impression of a central 'European forest' [73].

Figure 1. Contextual map; locating examples for Engagements [2] contexts, each project {no.}.

1.8 Engagement [2] (Common Frame)

The difference between arts practice and design practice has long since been contested. The authors align to (Frayling's) advance "learning, knowledge and professional competence, in the principles and practice of art and design in their relation to industrial and commercial processes and social developments" [74]. We know the multitude of differences between Art and Design and how long it's been discussed and strategically avoided here. Authors are interested in the positive crossovers of working with 'people' for new practices in engagement through learning, knowledge, and professional competence. This common field not only informs how we create, but its impact, its practice, and projects 'sustainability' outside of researchers circles for positive ecological transformation. We fully respect the differences and believe we can learn from each other creating Engagements [2]. Fundamental to all art and design education and training is the consideration of the user, consumer, audience, and spectator therefore it is not surprising that this is applied to art and design research.

1.9 Engagement Making

The Hackspace and the maker movement have been identified as means to (potentially) widen access to technology (ref) and craft and making (within makerspaces, repairs cafés and clubs) provide opportunities to promote social engagement and well-being benefits of making (together). Hence the opportunity to co-design spaces in which to hack technologies as a means to accentuate and deliberately foster, fabricate, and facilitate engagement as a both means and ends. The Brighton Place-Maker-Space {28} [75] 'hacked' the notion of hackspaces and deployed HCI's and making, using technology as a means to enact and craft engagement relating to the participants' community and local environment. The use of technologies and making themselves provide the basis for engagement around topics that generally disengage and disenfranchise such as environmental, urban and community planning. 'Hacking' the use of animation and augmented reality apps provides space and place-based media, to express unheard voices, generating empathy

with nature and envision how nature might thrive in cities through augmented-town-tapestries and gamified, virtual landscapes. Minecraft is used to engage collaborative visions of more biodiverse cities (Blockbuilders), engage people in complex ecosystems and enable interactions with nature at a scale and through media and making that is creative, expressive and, of course, engaging. My NatureWatch deploys the fabrication of an HCI (as an engagement) that brokers new and exciting interactions with nature (not formerly possible). These cases demonstrate the materiality of engagement as a tangible, malleable entity that can be desired, defined and designed, created, constructed, and curated – Moreover the process of hacking and making of the HCI (itself) forms the seminal catalyst and engagement that in turn unlocks connectivity that is deepens the relationship and generates meaningful interactions.

2   Method

The work draws from; interdisciplinary projects and case studies of the authors, working across HCI, design, arts practice, history of design and industry. 'Nature engagement' workshops, round table discussions and semi-structured participant interviews were documented and provided feedback. The participants represented organisations and bodies tasked with engagement within their public contexts making them key stakeholders (e.g., engagement directors and volunteer coordinators). Key informant interviews "allow[ed] a free flow of ideas and information, interviewers frame questions spontaneously, probe for information and takes notes, which are elaborated on later" providing information directly from experts [76]. The key informant interviews "provide flexibility to explore new ideas and issues not anticipated during planning" [77]. Interviewees included science engagement researchers, designers, and artists. Participants were interviewed individually, avoiding the "*Hawthorne effect* where participants behave differently when they know they are being observed" [78]. The interviewers were briefed, initiating from an identical script "enabl[ing] strict comparison between interviews" as it "is easier for a novice to follow" [79]. Interviews were clustered and thematically analysed into; clarity topics and emerging practices "covering key themes, concepts and ideas" [80].

- *How can carefully curated 'engagement(s)' form a new practice that is embedded, transitioning actions and communities?*
- *What are the opportunities and benefits for art and design practices to actively engage audiences, communities, users, viewers, spectators, and passers-by?*
- *How can these actions and outcomes affect long-term mutual benefit, and sustainable living?*
- *Can you offer any best practice examples of practice-based engagements and or comment on a code-of-ethics or code-of-conduct?*

3   **Results**

The following are excerpts from the interview series and then summaries from experts and literature.

1) How can carefully curated 'engagement(s)' form a new practice that is embedded, transitioning actions and communities?

"What social change might your participants want to see? How can projects help participants achieve that? Working together, and intertwining engagements is key, with community members and instigators of your engagement. There's different terms for that, co-production, co-design, etc. If they're genuinely an equal partnership, understanding both parties' aims, and working together is critical". **Expert 001**

"Within engagement practises, there are spaces for other species, using things we have, until now reserved for humanity. A massive question as 99.9% of what humanity does, puts humanity first and foremost. How can anything from an airport to the military, our homes to bridges become places for other species?" **Expert 003**

Authors summarise the criticality of; Comprehending all agendas, within projects so they meet those needs but also do not counteract alternate or unknown objectives, they might not be obvious. Ensure equality in all means, from inclusion, attribution, and dissemination. Create outputs holistically considering species/ecological impacts.

2) What are the opportunities and benefits for art and design practices to actively engage audiences, communities, users, viewers, spectators, and passers-by?

"Open communication with participants, [i.e,] everybody communicating. [It] is the only reason people say, 'you know that is not cool'. It's often research's problem, you get funded for fixed time periods. You're expected to co-design projects and build trusted relationships, where people can identify challenges. Ethics are really complicated and understanding what people mean. These things [all] take time, so we need longer term community relationships". **Expert 001**

"Part of Trolley Reef is its ability to let the oysters grow on top of each other, this makes oyster reefs a keystone species. The problem is that with 98% of oyster reefs gone and rebuilding a new reef means elevating the oysters away from silts. The project will set up a community owned oyster company, given to teenagers. By the time they grow up the oyster reef will be in a state where it can be harvested but the structural forms of the trolleys" **Expert 003**.

Authors summarise the criticality of the following elements. Clear communication and unification of terminology ensuring parties are not alienated or excluded. Question how the funding can establish legacies, these take time to establish. Finally thinking about exit and who projects are 'donated' to.

3) How can these actions and outcomes affect long-term mutual benefit, and sustainable living?

"Some projects are bleeding into your life, whilst you're cooking tea etc. You're wanting to build trusting relationships, it's hard to say, it's my day off, you can't really do that. It's hard to build those things into funding proposals. [Funders] are not going to give you funding to foster those skills". **Expert 001**

"The Trolley reef is a project that will probably not see complete fruition within my lifetime, so how we develop projects beyond the life of individuals is a critical perspective and opportunity within funding terms". **Expert 003**

Summarising the importance of; clarity on 'all parties' work through attribution and development of that attribution over time. Finally defining, what the "life and activities" of projects span as these need to be fostered through ambassadors.

4) Can you offer any best practice examples of practice-based engagements and or comment on a code-of-ethics or code-of-conduct?

"It's important not to forget those rely[ing] on traditional media, newspapers, radio, etc. I appear regularly on our local radio, and people ring me up afterwards or DM me on social media. It's really important not to forget that demographic. The drawback is that you can lose complexities of [some] issues". **Expert 004**

"It's luxurious to communicate with participants on WhatsApp in the evenings. You're on your phone, to keep those relationships going, for many people, you can't do all of that. Unless it's built into projects, or university systems. From an academia perspective, it's not going to change very much. **Expert 005**

"We develop codes of conduct/interdisciplinary working contracts, [through] co-designed workshops. They outline our expectations within the team. In terms of ethics, they need to be considered, on a project-by-project basis. There is psychological harm, or physical harm resulting from your project for both the researchers / practitioners running it and the project participants. Finally, data ethics and attribution of outputs". **Expert 005**

We summarise that; media typologies and how they reflect user groups and demographics are important to remember. Building 'appropriate means' and accessibilities into projects. For example, establishing HR processes that protect individuals and enable them to work when their participants are 'available', outside conventional hours. These could include Interdisciplinary working contracts or / agreements.

4   Discussion

Authors frame the HCI, design and arts space, share lessons from leading practitioners and then translate insights that can be applied to HCI contexts for deeper active engagement of audiences. *Engagements [2] as 'HCI Material'* guides readers through literature, projects, lessons, and analysed insights for repeatability and scalability. It is valuable to territories that overlap HCI, design and arts-based communities; intent on tackling contemporary sustainable and contextual issues. Previous literature [81] explored similarities and lessons learnt from design research projects carried out with geographic communities, within the context of inclusive design for social change. This identified findings such as: ensuring clarity of intent with participants around the brief; inclusive, co-defining and designing accessible engagement methods; matching motivations for a mutual exchange or transaction between designers and participants; and leaving responsibly, in terms of being upfront about the project ambitions, the duration of involvement of designers and meaningful

adoption of outputs by the community where possible and appropriate. Designing engagement - contributors articulated perspectives that recognise the role and expectations around engagement without definitive metrics or references to what engagement is, however, common attributes. Authors do not want to polarise with positive and or negative approaches. Authors believe these are challenges within this 'creative space', contextual points defining the backbone of Engagements [2]. We view these as different from convention as 'participants' might have more agency and be more deeply involved in decision making processes and potentially outside institutional boundaries. Findings from the interviews and territory present potential frameworks to more creative engagement(s). The following contexts (outlined in research objective) are defined, (but not exclusive to):

Ecological Citizenship: Fostering activities that benefit the local ecology or environment for example, appropriate mapping, reduction in waste or inform behaviours toward more sustainable practices. For example, Google Maps already informs users of the lowest carbon emission impacts to inform journey decisions [82]. These 'actions for more sustainable communities' are transferable and scalable.
Re-naturing: Mapping spaces (accurately) so they can be cultivated to help more species diversity and reduce invasive species. Providing the ability to internationally see food growing conditions that can be replicated, based on facts and data. Finally, document species diversity accurately through community-led digital documentation.
Participant Motivations: Unpick local communities' aspirations to align their contextual motivations, with appropriate goals.
Climate change: A wicked problem that needs unpicking, but could inform our predicted behaviour and make suggestions, or determine our lowest impact choices.
Material Consumption: Digitally showing the provenance of the material(s), informing purchasing decisions and/or its impacts. Demonstrating new methods for how materials can be re-used or disassembled appropriately.
Repair Culture: Leveraging HCI to compliment physical systems with: VR, AR, or digital platforms to share materials. For example, BMW initially explored VR for staff training purposes [83]. With the financial reduction of technologies, these approaches can become more commonplace.

4.1   Value to HCI Practice

Agendas: align what 'success is' for parties, this is common practice in Citizen Science (CS). CS unites 'project design', technologies, accessibility, and science.
Motivation(s): align interests of; participants, municipality, and organisation.
Ethical: issues of paying participants (meeting minimum wage) as it is unethical if participants cannot afford to be involved.
Inclusion: create processes that include participants and potentially can become stakeholders providing, agency: to local communities.
Designing for Exit: build in self-sustainability or resourcing to create legacies.
Over-selling success: do not over promise and/or creating something that is unsustainable for researchers and communities.
Commodities: for academic institutions REF material is paramount, however these can be clarified. For corporations IP and licensing models can be paramount.

Sustainable Legacies: Projects reliant on legacy funding. Build trusted ambassadors, within communities. They should be within resource/financial constraints.
Authorship & IP: when ownership is passed over to social innovation how are initial parties protected? and what happens if engagement has negative consequences?
Social Capital: build the 'personable art' of managing relationships, expectations etc.
New fields: i.e., the opportunity to create social innovations and spread opportunities.
Transparency: projects must fulfil certain criteria and have caveats. Understanding (appropriate) technological adoption. i.e., making the "material" or data that is gathered 'good quality' comparable and usable.

4.2   Summary

These actions and outcomes affect long-term mutual benefit. The authors summarise from the results, literature, and interviews that the following are the key repeatable steps to optimise Engagements [2].

1. **Platform Creation:** Be flexible and create a clear means for all to contribute and have ownership.
2. **Designing for Exit:** Providing transitions i.e., when participant(s) and researchers leave, infrastructure(s) must be self-sustaining.
3. **Leveraging the everyday:** Building embedded interactions in environments (Bus stops, parks), non-embedded, (smartphones).
4. **Cultural Institutions:** A mediator to deliver sustainable practices through HCI / interactions located in/or around them.
5. **Accessibility / affordability:** The tools can be 'a smart phone' and the physical space. We see the material as the process in which creatives use and deploy. This opens the experience, the interactions, the opportunities, and unified experiences.
6. **New areas for interaction(s):** Urban Barley Field, opens up a digital design space of how and where people can grow food, ownership, and its care. Authors see Engagements [2] as a means to open-up new domains and territories.

5   Conclusion

Authors conclude that we must leverage creative practice well beyond problem solving and leveraging communities. For example, NW used serendipity, to open up possibilities for participants. In *Politics of the Everyday* Manzini states we must "create the conditions" [84]. The question is how do you 'set the right conditions', to ensure cross-generational motivations. Authors do not have a 'fix all' position so; place, demographic, inclusion, finance etc must be quantified. Authors believe *Engagements* [2] is a discipline in its own right. It is not just 'mixed media', service design, or 'raising awareness'. The key is how is it validated academically and by other communities? As the relationship is often backward; for example, funding research you need to know what 'could' happen, however fostering relationships needs to encourage ownership, serendipity and enable choice. Engagement is considered one stage towards impact (UKRI); however, authors assert it is one of the most significant considerations that artists/designers make in the process of cultural production and in this context is part of the research process. Moreover, and

importantly for *Engagements* [2] (as material) is that the relationship between parties is an integrated collaborative exchange? I.e., the artist/ designer does not solely rely on the participant to resolve the design problem or interpret the artefact. Rather, they recognise that the spectator is not automatically furnished with the capacity to translate works of art and design - at least not straight away - but needs to engage in a kind of creative labour which is as much about transforming oneself as it is about knowing the work. This entails negotiating the places constructed by the design object, artefact, exhibition, or event, of altering oneself so as to occupy the new place designated by the work [85]. For example, Environmental Design requires both designer and user to transform the current understandings and situate themselves in a paradigm to imagine alternative behaviours, routines, and practises, it is this process we identify in Engagement as Material. In the same way, artefacts are sometimes described as unfathomable. We assert that this act of transformation is the place where art and design research is situated, and we aim to identify this significant methodological contribution to society by articulating it as a type of material. Authors believe that translating practice to audiences, doing good, fostering debate, assisting others is our role as practitioners. The final question is how you design *'Engagements* [2]*'* that is opaque, ensures safeguarding of; physical-self, mental health, finance with elements protected, even during researcher exit.

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