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ImaginationLancaster: Open-Ended, Anti-Disciplinary, Diverse

Abstract The paper is the story of building a design research group from scratch. As there has been some recent interest in design research as a team based activity, this article illustrates how we built the Imagination research team and how it continues to develop. This article gives us the chance to reflect on how far we have come in the last decade. Once we were a few dedicated members of staff wanting to bring design research to a small university in the north of the UK. Now we are one of the leading centers of excellence worldwide for design research. This article uses case studies from research projects and Ph.D. research to demonstrate Imagination's research philosophy – open-ended and anti-disciplinary. We celebrate the plurality of ways design research is carried out. The article highlights how we use design research to address global challenges, and how these have also shaped our teaching and further research. We end by considering the value of design research and how we, as a team, can take Imagination forward into the next decade.

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Our Origins

When Rachel Cooper became the director of the newly formed Institute for the Contemporary Arts at Lancaster University in June of 2006, she was given a unique opportunity.[1] A philanthropic donor wanted her to use a £3 million gift to bring world class research and teaching to Lancaster. With this, Imagination was born.

The initial brief from the university was straightforward – we were asked to build a center that would return the original £3 million investment within five years. However, the philosophy developed by Cooper and the original academic members was for Imagination to take design research beyond its disciplinary silos to address global challenges in relation to people, places, services, and interactions by enabling design led research to apply theory and practice in collaboration with other disciplines. We consciously chose not to include the word design in the name, even though design was a new discipline at the university. We chose to call the center *Imagination* instead, to illustrate how design research contributes to and helps people imagine futures. We wanted to develop Imagination as a laboratory where individuals and organizations could engage with academia in dynamic and creative ways. This structure supports our belief that innovation and creativity occur along disciplinary boundaries, and our feeling that we will only find answers to problems at the place where science, technology, social science, humanities, and the arts converge. From the outset, we saw Imagination at Lancaster as an open, exploratory research lab tasked with investigating emerging issues, technologies, and practices to advance knowledge and develop solutions that contribute to the common good.

Beginning with a group of seven academics, Imagination launched at the Design Museum in November 2007. With the help of Kevin Roberts (CEO of Saatchi & Saatchi), we built the team and the Imagination strategy around an explicit purpose statement (Figure 1). We revised the purpose statement in 2014 and again in May of 2018 (Figures 2 and 3). The first statement was built around our ambition and desire to grow the group and our research. The 2014 and 2018 statements reflect that growth and our confidence in the work we were doing. The first purpose statement was kept as an internal document for the team, whereas the second and third were published on the Imagination website. Taken together, the three statements reflect our progress and expansion. In the beginning, we were focused on developing the research group and making it come alive. Seven years later, with double the staff, we were interested in making Imagination brilliant, even though our character and purpose had only subtly changed. By 2018, with so many new team members and new leadership, it was time to repurpose ourselves again.

At our launch in 2007, our focus was on top down academic and strategic priorities – to grow our research income and our PhD numbers (see Figure 4). We developed a master's program in 2010 and, four years later, an undergraduate program. During the earliest years of Imagination, we introduced design to other faculties, including management, and in 2008, Lancaster University Management School launched an undergraduate program in marketing and design.

From the seven people who originally launched Imagination in 2007, we have grown to a team of over 15 tenured academics, 12 research fellows, seven professional services staff, and over 48 PhDs. We have now graduated over 45 PhDs and 142 master's students. In 2008, we were given the opportunity to commission a new Imagination Lab as part of a new £10 million building, and in 2010 we moved into a dedicated space where we could practice what we preach and deliver our research in a uniquely designed space.

We have often asked ourselves what makes Imagination special. We believe that part of our uniqueness lies in the breadth and diversity in our approaches to design research. This, combined with the openness of our interactions with the rest

1 **Editorial note: while the body text conforms to U.S. English, all project titles and institution names adopt British English where appropriate.**

Figure 1 Imagination first purpose statement 2007. Copyright © 2007 Imagination-Lancaster.

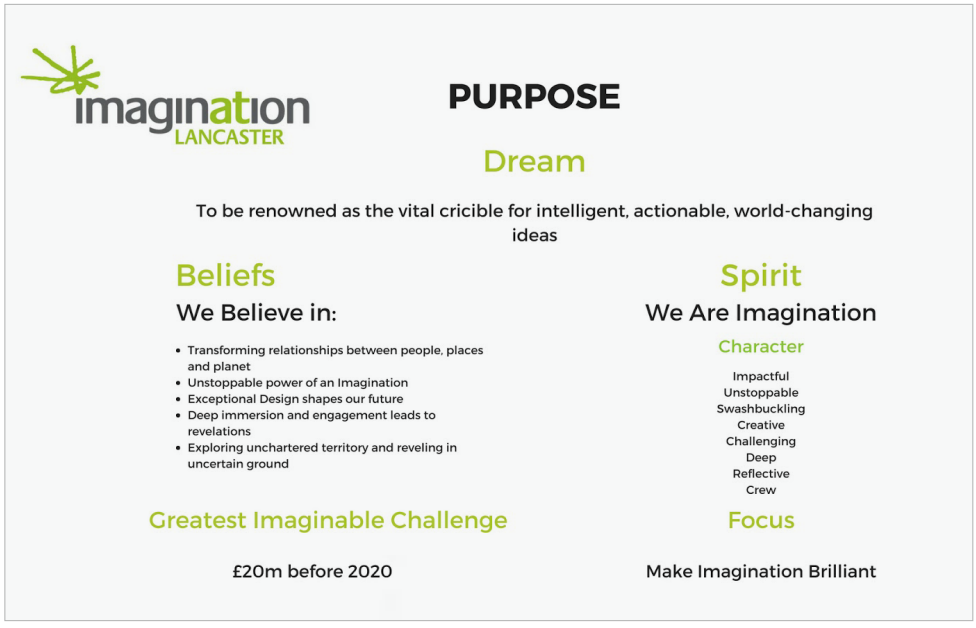


Figure 2 Imagination second purpose statement 2014. Copyright © 2014 Imagination-Lancaster.

Figure 3 Imagination third purpose statement 2018. Copyright © 2018 Imagination-Lancaster.

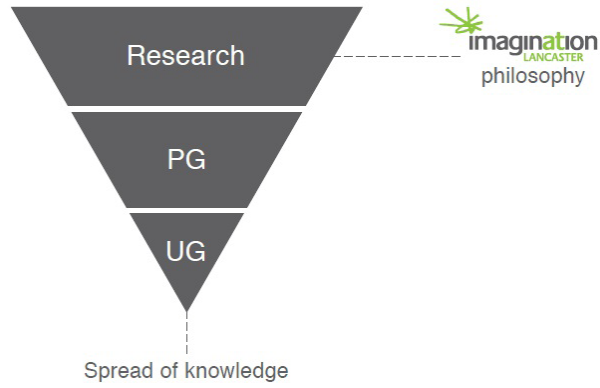


Figure 4 Diagram showing how design research informs design education. Copyright ©2018 ImaginationLancaster.

of our university and with other groups from various disciplines nationally and internationally, and given the different contexts in which we apply our thinking, makes us truly unique. Our critical mass and identity as a design team is vital. Everyone on the academic team has a PhD and actively contributes to our research program.

From the outset, our focus has been on action and reflection, building a team culture, and looking outwards. This article – with contributions made by every team member – explains and reflects on our approach to design research. We will also provide examples of the research we are doing or have recently completed to illustrate our philosophy and demonstrate our impact and engagement beyond the academy.

Imagination Philosophy: Co-design, Speculative Design, and Practice-Based Research

Research plays a fundamental part in the processes of designing and developing future products, services, systems, and environments. In most design situations, research takes on one or more forms, including observing what people do in various situations, asking questions, searching for information, making and testing prototypes, challenging assumptions through designed provocations, experimenting with materials and processes, and speculating on fictional future visions.[2] Design research at Imagination takes an open ended, anti-disciplinary approach that celebrates the multitude of ways people conduct design research and how this research will be seen, heard, and acted upon.

Our design research is based upon different ways of doing, thinking, and interacting, and is inclusive in scope. We adopt a mélange of different approaches and cultures. Imagination promotes a design research philosophy that includes experimental, collaborative, speculative, inductive, explication-based, practice-based, hybrid, and hacked[3] approaches and methods. Various cultures coexist in contemporary design research, and this pluralism is encouraged throughout the Imagination Lancaster ethos. Today, design research methods and approaches need to fit their purpose. Thus, we believe that design research should continue to borrow and hack methods and approaches that fit from the physical sciences, the social sciences, and the arts and humanities if and when the situation arises.

Over the past couple of decades design has broadened its skill base and its application. For instance, service design[4] has introduced new opportunities to improve the delivery of products and services within and outside the healthcare system.[5] Behavior design, grounded in psychology and behavioral change theory, has enabled designers to "design out" barriers found across objects, services, spaces, and environments[6] and influence and shape human behavior.[7] In the policy

2 Paul A. Rodgers and Joyce Yee, eds., *The Routledge Companion to Design Research* (Abingdon: Routledge, 2015).

3 Merriam-Webster's dictionary defines a *hack* (n.) as "a usually creatively improvised solution to a computer hardware or programming problem or limitation." In the real world, where one-size-fits-all, static solutions have become inappropriate to address complex problems, the noun has become an adjective and a verb, signifying (arguably) "improvise/ed according to circumstantial need." Merriam-Webster, s.v. "hack (n.)," accessed November 8, 2018, https://www.merriam-webster.com/dictionary/hack.

4 Anna Meroni and Daniela Sangiorgi, *Design for Services* (Aldershot: Gower Publishing Ltd., 2011).

5 Paul Bate and Glenn Robert, "Experience-Based Design: From Redesigning the System around the Patient to Co-designing Services with the Patient," *BMJ Quality & Safety* 15, no. 5 (2006): 307–10, DOI: https://doi.org/10.1136/qshc.2005.016527; Seunghae Lee, "Evaluating Serviceability of Healthcare Servicescapes: Service Design Perspective," *International Journal of Design* 5, no. 2 (2011): 61–71, available at http://www.ijdesign.org/index.php/IJDesign/article/view/919.

6 Kristina Niedderer et al., *Creating Sustainable Innovation through Design for Behaviour Change: Full Project Report* (Wolverhampton: University of Wolverhampton, Project Partners, and AHRC, 2014), available at https://dspace.lboro.ac.uk/2134/17410.

design field, new approaches to developing policy and aiding innovation in organizational, local, regional, and national governance are emerging.[8] Designing interactions is a new way of considering how we can improve the relationship between people, artifacts, places, services, and even technologies, such as in the realm of the Internet of Things (IoT).

User-centered design has led to participatory design, co-design, and co-creation[9] – we are seeing a much closer relationship between design professionals and the individuals and communities who have a stake in the outcomes of design activity.

At Imagination, we have pursued these dimensions of research and also challenged them. For example, our colleagues Paul Coulton and Joe Lindley are currently addressing the relevance of user-centered design for IoT.[10] Thanks to our expertise, interests, and international connections, we have been working in these and many other emerging design fields.

In the remainder of the article, we will present our design research by domain: design management, policy, and leadership; design for sustainability, health and well-being, urban environments, manufacture, communities, and society; and lastly, design futures. We also introduce case study examples of projects where we illustrate the scope of the work we do and our design research philosophy. We will conclude with an explanation of how our approach to design research informs our educational programs.

Domains

Design Management, Policy, and Leadership

The origins of Imagination lie in the knowledge the team have in design management and policy – how design is managed, how organizations and communities apply its tools and techniques, and how it contributes to policymaking. These three domains of inquiry underpin all of our research and education programs. The research we undertake contributes to the field both directly (see Case Study 1: Design Values) and indirectly (see the case studies under the section entitled "Design For…").

Our design management and policy work focuses on how design is used and valued inside organizations. For example, Design 2020[11] included a study of the future of the UK Design Industry, and our EU project *Design in European Policy* saw us working with colleagues throughout Europe to develop a framework for embedding design at the European level.[12] One of our recently commissioned research projects aims to understand the relationship between design and innovation, and what design contributes to the innovation process (see Case Study 1: Design Values).

In terms of leadership research, our Imagination colleague Paul Rodgers holds the Arts and Humanities Research Council (AHRC) Design Leadership Fellowship entitled *Design for Change*.[13] The key aims of this fellowship are twofold: to increase the quantity and quality of design-led research proposals and strengthen the research capacity of the next generation of design researchers (early career researchers) in the UK; and to act as an ambassador for design research across all sectors of UK society so that design research becomes a tool for delivering real and positive social change. This will help achieve real and long-lasting transformation and impact, and lead to change that will make an actual difference to the lives of individuals, groups, communities, and UK society as a whole. Working collaboratively with researchers in other disciplinary areas, Paul takes the lead in identifying opportunities for collaboration, trends in research, and organizing events on behalf of the AHRC. He works to shape preferred realities and positive future visions around key challenges – sustainability, health, security, care, poverty – where

7 Susan Michie, Maartje M. van Stralen, and Robert West, "The Behaviour Change Wheel: A New Method for Characterising and Designing Behaviour Change Interventions," *Implementation Science* 6, no. 1 (2011): 42, DOI: https://doi.org/10.1186/1748-5908-6-42.

8 Christian Bason, ed., *Design for Policy: Design for Social Responsibility* (Farnham: Gower Publishing, 2014).

9 Elizabeth B.-N. Sanders and Pieter Jan Stappers, "Co-creation and the New Landscapes of Design," *CoDesign* 4, no. 1 (2008): 5–18, DOI: https://doi.org/10.1080/15710880701875068; Lieven De Couvreur and Richard Goossens, "Design for (Every) One: Co-creation as a Bridge between Universal Design and Rehabilitation Engineering," *CoDesign* 7, no. 2 (2011): 107–21, DOI: https://doi.org/10.1080/15710882.2011.609890.

10 Joseph Lindley, Paul Coulton, and Rachel Cooper, "Why the Internet of Things Needs Object Orientated Ontology," *The Design Journal* 20, no. sup1 (2017): S2846–57, DOI: https://doi.org/10.1080/14606925.2017.1352796.

11 Alex Williams, Rachel Cooper, Martyn Evans, and Qian Sun, "2020 Vision—The UK Design Industry 10 Years On: Implications for Design Businesses of the Future," in *Designing for the 21st Century Volume 2: Research Methods & Findings*, ed. Tom Inns (Aldershot: Gower, 2009), 39–54.

12 Tapio Koskinen and Michael Thomson, *Design for Growth & Prosperity: Report and Recommendations of the European Design Leadership Board* (Helsinki: DG Enterprise and Industry of the European Commission, 2014), available at https://publications.europa.eu/en/publication-detail/-/publication/a207fc64-d4ef-4923-a8d1-4878d4d04520#.

13 For more information, please visit https://www.designresearchforchange.co.uk/about/.

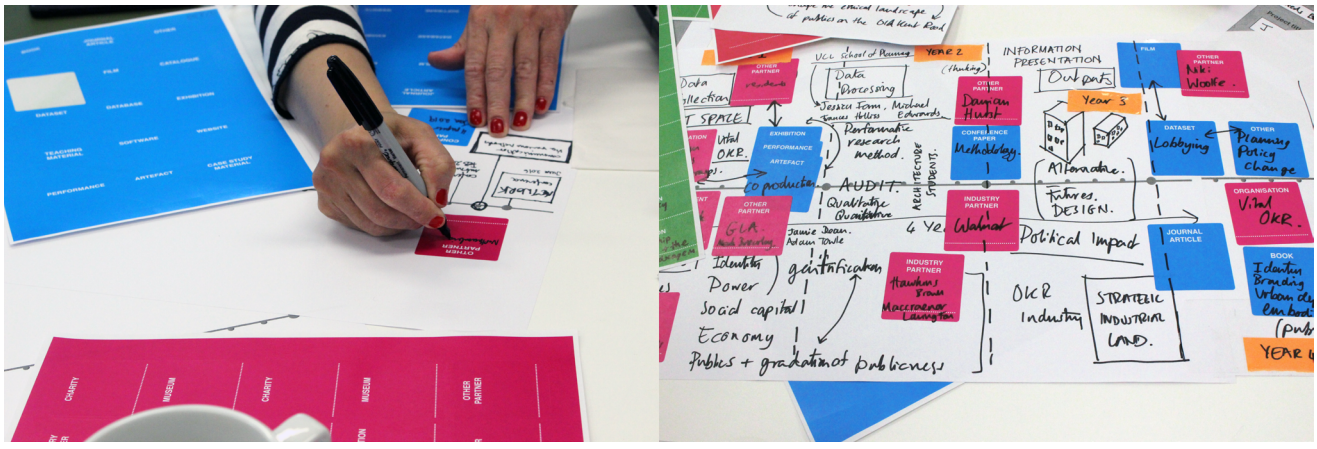


Figure 5 Next Generation Design Research workshops. Copyright © 2018 Paul Rodgers.

design thought and action is key. For example, this may involve the co-design and co-development of novel products that will lift people out of poverty. It might include the design of innovative services in care that will improve the health and well-being of families across the country. It may also include the design and development of new policies that will reduce further harm to our planet. Paul's focus is inclusive – his projects adopt and utilize a mix of different types of design research. This demonstrates the various cultures of design research can coexist, and celebrates this pluralism in what is rapidly becoming a very healthy and mature field of research. As part of this work, Paul held eight *Next Generation Design Research* workshops across the UK between late 2017 and early 2018 (Figure 5). Nearly 700 participants attended, which has helped galvanize the design research community – especially early career design researchers – and helped all to share expertise and build collaborations for future research activities. The findings from this work will be published in the near future.

Case Study 1: Design Values

The Role of Design in Innovation was an eighteen-month AHRC funded research study carried out in collaboration with Innovate UK and the UK Knowledge Transfer Network Special Interest Group on Design. The aim was to identify the roles design can play in innovation, the contributions of those roles to certain forms of innovation, and the conditions under which these contributions actually happen.

Studies on the definitions, uses, value, and impact of design such as *The Cox Review of Creativity in Business*,[14] *Leading Business by Design*,[15] and *Design – Measuring Design Value*[16] have helped to build confidence in the field, and expand understanding of its strategic position in industry. While these studies demonstrate power of design and, in some cases, make a close approximation to the monetary value design creates, the nuances of any causal relationship between design and innovation remain unclear. Both in the academic literature and in practice, beyond a few successful case descriptions, the specific process by which design enables certain forms of innovation is essentially vague. Moreover, the conditions under which design can be embedded into organizational culture and help organizations innovate over the long term are also not well defined.

This study gathered evidence to build a clearer picture. While conveying the complexities of the relationship between design and innovation, it also identified the specific conditions under which design contributes to innovation, the specific forms of innovation, and the forms of these contributions.

Quantitative and qualitative data collection took place through an online survey and a series of in-depth interviews. We worked in close collaboration with Innovate UK to devise and conduct a questionnaire administered to a wide group

14 George Cox, *Cox Review of Creativity in Business: Building on the UK's Strengths* (London: Her Majesty's Treasury, 2005), available at http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/independent_reviews/cox_review/coxreview_index.cfm.

15 Design Council, *Leading Business by Design: Why and How Business Leaders Invest in Design* (London: Design Council, 2013), available at https://www.designcouncil.org.uk/sites/default/files/asset/document/dc_lbbd_report_08.11.13_FA_LORES.pdf.

16 Eusebi Nomen and BCD Barcelona Design Centre, *Guidelines for Collecting and Interpreting Design Data: A Proposal for a Barcelona Manual on Design*, ed. Barcelona Design Centre et al. (2014), available at http://www.measuringdesignvalue.eu/index.php.

of businesses. We asked about their innovation practices, R&D investments, drivers and barriers to innovate, and their understanding and use of design, including the motivations and factors hindering that use. We also obtained qualitative data via fifteen semi-structured interviews with a group of businesses across the UK covering four major areas of interest: urban living, transport, digital economy, and manufacturing. The interviews and survey were divided in three parts: design, design and innovation, and protection of designs and innovations.

In the analysis carried out on the survey and interview results, we divided companies according to their position on the Design Ladder.[17] The understanding and uses of design varied substantially among the companies, and but overall most perceived design as being multifaceted, rather than a single, easily defined activity.

The analysis indicates that design played at least three distinct roles in the companies: design activity contributed directly to developing innovative products, services, and markets; the design process helped to accelerate and de-risk innovation activities; and design practices contributed to product and services marketing and brand building overall.

Companies that used design as process or as a strategy considered capabilities in R&D and design to be equally important. The majority of these considered both to be critical to their competitiveness. Design capacity was ranked among the five most important sources of competitive advantage. The companies in the non-design or design as styling group had typically introduced one more innovations during the last three years than those in the other groups, but on average they achieved a lower share of sales from their innovations.

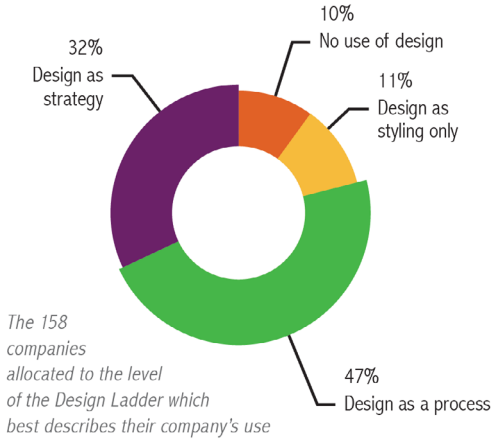


Figure 6 Graphic taken from *Design Value Report* detailing how companies use design. Copyright © 2016 Imagination-Lancaster.

The roles and contributions that design makes to innovation are strongly related to the definitions and uses stakeholders attribute to design. Those definitions and uses locate design at different points in the innovation process, generating different kind of impacts. Despite the recognition of the value of design and its importance for innovation, companies typically found it very difficult to measure the return of investment made in design (Figure 6). This was partly due to the conceptual and practical problem of separating design from other activities contributing to innovation. The main ways companies have to measure and understand the value created by design in their innovation activities are via feedback from their clients and the performance of their innovations in the marketplace. If client feedback is positive and the sales of introduced innovations are strong, companies usually see this as a consequence of a good use of design. In summary, the findings indicate the great majority of the companies – especially those that use design as process and strategy – realize significant benefits from engaging in design. There are several indications that these companies outperform those that either do not engage in design or limit their engagement in design to styling. But even among this latter group, a large share report that there are benefits to engaging in design that stretch beyond those associated with a narrow use of design as styling.[18]

Design for Sustainability

The terms sustainable development and sustainability have become embedded in our vocabulary and our thinking for several decades. It is now a critical topic in terms of thinking about our population and planet as recognized by several reports, most recently the IPCC report.[19] They generally refer to a range of methods, practices, and measures put in place to address the environmental, social, and economic issues associated with meeting ongoing human needs and aspirations on

17 We combined non-design and design as styling companies into a single category due to the small number of respondents in these two groups. See "The Design Ladder: Four Steps of Design Use," Danish Design Centre, last modified May 6, 2015, https://danskdesigncenter.dk/en/design-ladder-four-steps-design-use.

18 Further findings from the study can be found in the *Design Value Report*, available at http://imagination.lancs.ac.uk/news/Design_Value.

19 IPCC (Integovermental Panel on Climate Change), "Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C Approved by Governments," news release 2018/24/PR, October 8, 2018, https://www.ipcc.ch/news_and_events/pr_181008_P48_spm.shtml.

a changing planet. More recently, the terms have also come to embrace concerns related to individual flourishing, well-being, and fulfilment, as well as questions of meaning and purpose and the overcoming of disenchantment that has arisen in the modern period.

Design for sustainability has become an important area of concern for designers, design researchers, responsible companies, and the wider public. The field necessarily focuses on context, place, and localization. At Imagination, we approach sustainability research from many angles, including the social, personal, and environmental benefits that can arise from design research. Stuart Walker focuses on this through his research on context, place, and localization. His work illustrates that social and personal benefits can accrue by building a sense of place and a sense of community. This addresses issues of social cohesion, cultural identity, and a sense of belonging and well-being. Environmental benefits also accrue by reducing the need for shipping and packaging, and their related emissions and waste issues, while also encouraging environmental stewardship and care for place in conjunction with economic enterprise. The products of place will have a certain quality of cultural distinctiveness and sense of provenance, thereby allowing our material productions to take on layers of meaning and cultural significance that, in a small way perhaps, begin to "re-enchant" our human made world with traditions, histories and stories that weave together people, place and profits. So, we approach sustainability through practice and qualitative, and quantitative research methods, as we do all of our research.

Case Study 2: Design for Life—Creating Meaning in a Distracted World

If we are to deal effectively with the negative consequences of our contemporary worldview, it is necessary to develop a new kind of normal. To do this, we must use creativity, stimulate the human imagination, synthesize the rational with the intuitive, and develop a more comprehensive sense of narrative unity for our human story. This project developed over a three year period embraced a variety of interrelated modes of engagement including *writing* (ideas and theory development, the means of application, funding applications); *propositional design work* (concrete examples of "counterpoint objects" that expressed and informed the developing theory); *workshop* (with young people to develop engagement opportunities, test ideas, garner feedback in an engaged, involved manner); *exhibition* (of "counterpoint objects" to present ideas to members of the public as well as fellow researchers, in order to garner feedback); *symposium* attended by researchers, students and members of the public; a dedicated *website* with images, texts, and video of symposium; and publication (a book of the same name, plus various journal and conference papers).

The project takes as its premise that design, as both process and product, can be an appropriate means of contributing to positive change—through visualization and demonstration that, unlike solely written arguments, is instantaneous perceived, intuitively received, and concrete/real. For these reasons, design can be especially effective at conveying complex ideas quickly and stimulating thoughts, ideas, and conversations. Through design, we can visualize the limitations of our current modes and demonstrate creative possibilities based on new understandings. Positive change through design can be considered in several ways—as incremental improvements within the current production system; as grassroots development of alternative approaches; as objects that provide a focus for contemplation and deeper understandings; and even as counterpoints that critique current norms by expressing a contrasting position. During this project, the researcher developed a number object examples, including "counterpoints," which demonstrated, in a tangible way, how design can be employed to challenge norms and manifest ethical

20 Ed Diener, "Guidelines for National Indicators Of Subjective Well-Being and Ill-Being," *Journal of Happiness Studies* 7, no. 4 (2006): 397–404, DOI: https://doi.org/10.1007/s10902-006-9000-y.

21 Kirsty Morrison, "Hospital Beds: Innovation, Design, Research and Analysis," *The King's Fund*, last updated January 22, 2015, https://www.kingsfund.org.uk/blog/2015/01/hospital-beds-innovation-design-research-analysis.

22 Peter H. Jones, *Design for Care: Innovating Healthcare Experience* (New York: Rosenfeld Media, 2013); Francesca Tosi, Alessandra Rinaldi, and Daniele Busciantella Ricci, "Ergonomics and Inclusive Design: Innovative Medical Devices for Home Care," in *Advances in Design for Inclusion: Proceedings of the AHFE 2016 International Conference on Design for Inclusion*, ed. Giuseppe Di Bucchianico and Pete Kercher (Cham: Springer-Verlag, 2016), 401–12, DOI: https://doi.org/10.1007/978-3-319-41962-6_36.

23 Susan Mawson et al., "Developing a Personalised Self-Management System for Post Stroke Rehabilitation; Utilising a User-Centred Design Methodology," *Disability and Rehabilitation: Assistive Technology* 9, no. 6 (2014): 521–28, DOI: https://doi.org/10.3109/17483107.2013.840863; David Loudon, Anne Taylor, and Alastair S. Macdonald, "The Use of Qualitative Design Methods in the Design, Development and Evaluation of Virtual Technologies for Healthcare: Stroke Case Study," in *Virtual, Augmented Reality and Serious Games for Healthcare 1*, ed. Minhua Ma, Lakhmi C. Jain, and Paul Anderson (Berlin and Heidelberg: Springer-Verlag, 2014), 371–90.

24 Roger S. Ulrich et al., "A Review of the Research Literature on Evidence-Based Healthcare Design," *HERD: Health Environments Research & Design Journal* 1, no. 3 (2008): 61–125, DOI: https://doi.org/10.1177%2F193758670800100306; Paul Chamberlain, Daniel Wolstenholme, Matt Dexter, and E. Seals, *The State of the Art of Design in Health: An Expert-Led Review of the Extent of the Art and Design Theory and Practice in Health*

Water: a modern history

silent spring
acid rain
conflict mineral
fracking well
three mile island
torrey canyon
commodification and contamination

Oedipus Eyeglasses
accessory to an existential crime

we have so violated the Earth
our own survival is threatened

an existential crime
is attended by self-blindness

not recommended

Figure 7 Counterpoint objects with descriptions from the *Design for Life* project. Copyright © 2018 Stuart Walker.

considerations. These were presented, with accompanying explanations, theoretical bases, and descriptions in publications as well as through exhibition and symposium presentation, and to a broader audience through a film of the symposium presentation via a dedicated website and accompanying film. Figure 7 shows examples of two such counterpoint objects.

Design for Health and Well-Being

One of the most complex global challenges today is improving well-being and developing strategies for promoting health and preventing ill-being[20] among the population. Ever since the *King's Fund Hospital Bed* project[21] began in 1962, designers have been undertaking projects for health; architects have been designing hospitals ever since these institutions were established. Traditionally, designers have paid particular attention to supporting acute and chronic care by designing new medical products and prostheses, and via hospital, clinic, and care home design.[22] They have focused on restoring health through design and technology.[23] More recently, the complex picture of maintaining population well-being and preventing ill-being has begun to emerge, and thus the role designers play is changing significantly as they work to support the promotion of healthy lifestyles.

A number of authors[24] have demonstrated the propensity of design to contribute significantly to the domains of health and well-being. A key agenda going forward – and requiring immediate attention – is that of preventative healthcare. As the costs of healthcare delivery are increasing,[25] design is called upon to address such challenges. The issue is how to reduce the cost and burden of disease, particularly of non-communicable disease, by focusing more research work around prevention and looking at how design can work in prevention.

Design research at Imagination in the areas of design for health and well-being and design for the ageing population have taken on several forms,[26] notably in the work of Paul Rodgers. One of his projects developed a range of design interventions to explore how to disrupt the cycle of well-formed opinions, mindsets, and ways of doing which often remain unchallenged in the health and social care of people living with dementia. Many misconceptions surround dementia sufferers, which

***and Social Care* (Sheffield: Sheffield Hallam University, 2015), available at https://www.designinhealthnetwork.org/; Emmanuel Tsekleves and Rachel Cooper, eds., *Design for Health* (London: Routledge, 2017).**

25 John Appleby, *Spending on Health and Social Care over the Next 50 Years: Why Think Long Term?* (London: The King's Fund, 2013), available at https://www.kingsfund.org.uk/publications/spending-health-and-social-care-over-next-50-years.

26 Max Roser and Esteban Ortiz-Ospina, "World Population Growth," *OurWorldinData*, last modified April 2017, https://ourworldindata.org/world-population-growth.

Figure 8 Images taken from the *Disrupting Dementia* exhibition in Dundee (2016). Copyright © 2018 Paul Rodgers.

can perpetuate stigma, isolation, and generally negative reactions. Rodgers devised and undertook his disruptive interventions from a "designing with" perspective – the user is not a subject but rather an active partner in the project.[27] His open approach to working with dementia patients recognized and utilized the inherent personal creative abilities that they and every individual possesses, no matter their cognitive ability.[28] In this sense, research participants become collaborative designers helping to propose possibilities, evaluate and select solutions, give their knowledge and skills freely, and generally "make things happen."[29] (See Figure 8.)

Other work on health and well-being can be context specific, such as through service design in healthcare facilities. For example, a project led by Rachel Cooper centered on design for health service providers in the UK National Health Service and investigated existing frameworks for Practice Based Commissioning (PBC).[30]

The next case study offers another context-specific example from Emmanuel Tsekleves' work on geographical environments. In the next section, you will find one more, this time from Chris Boyko and Claire Coulton, on well-being and walkability in urban environments.

Case Study 3: Dust Bunny

Bacteria found in the natural and built environment – homes, schools, hospitals, and so on – are becoming resistant to antibiotics. What this means is that in the not-too-distant future, something as simple as a minor wound infection could become life-threatening. This is such a concern that antimicrobial resistance (AMR) is now considered a global health crisis, far surpassing outbreaks of diseases such

27 Elizabeth B.-N. Sanders and Pieter Jan Stappers, "Probes, Toolkits and Prototypes: Three Approaches to Making in Codesigning," *CoDesign* 10, no. 1 (2014): 5–14, DOI: https://doi.org/10.1080/15710882.2014.888183.

28 Paul A. Rodgers, "Co-designing with People Living with Dementia," *CoDesign* 14, no. 3 (2018): 188–202, DOI: https://doi.org/10.1080/15710882.2017.1282527.

29 Paul A. Rodgers and Euan Winton, "Breaking Well-Formed Opinions and Mindsets by Designing with People Living with Dementia," in *Breaking Down Barriers: Usability, Accessibility and Inclusive Design*, ed.

Figure 9 Pills versus design and behavioral practices from the *Dust Bunny* Project. Copyright © 2018 ImaginationLancaster.

as Ebola and as threatening as climate change. This is even more evident and critical in developing countries in Africa such as in Ghana, where there are a great number of deaths from infectious diseases. Social inequalities have led to homes that vary in quality and type. This, coupled with typically poor levels of domestic hygiene influenced by a number of economic, educational, and religious factors, has contributed to the spread of infectious diseases.

Within this context, and in addressing the Sustainable Development Goal to ensure healthy lives and promote well-being,[31] Emmanuel Tskeleves's current project (2017/2018) is aimed at developing an understanding of the home as a source of bacterial infection resistant to antibiotics and found and carried by dust. This is done by exploring hygiene practices across different home environments in Ghana, with the ultimate goal to reduce bacterial infection in the home environment and thereby reduce AMR. Understanding the hygiene practices in the household and interactions with airborne AMR bacteria will serve as a first step to designing appropriate education/information dissemination materials for various sections of the Ghanaian population as well as other developing countries in Africa. *Dust Bunny* uniquely combines design research and microbiology to provide an informed assessment of societal practices in domestic cleanliness and novel solution to reduce infections in the home (Figure 9).

Design for Urban Environments

Urbanization processes will determine the future of humanity on Earth – regardless of whether we and generations to come choose to live in cities or not – because the effects of urban development are planetary. The urban design research we conduct therefore seeks to directly inform policy and have impact across a range of built environment professionals. This work includes reports for national government, advisory roles to international bodies, strategic public engagement, white papers, and accessible guides for both communities of interest and practice regarding the local urban environment. Key to understanding how and why urban design may transform place is developing a methodology for unpacking where and when it connects to different audiences and decision makers. At the core of this methodology is an extensive analysis and subsequent synthesis of visions for place and improving how they may be comprehended. Our approach is multi-method, collaborative, often conducted with colleagues from other disciplines and universities, and sometimes undertaken individually in lone scholar mode.

One example of such work is *A Visual History of the Future*,[32] a report produced in 2014 for the UK Government Office for Science as part of their Foresight Future of Cities program. The report organizes and describes human imaginings and visualizations of future cities according to six visually dominant paradigms (Figure 10[33]). This overarching perspective offers scholars and other stakeholders an important resource for catalyzing ideas and rethinking future cities more broadly. One of the principal and positive trends going forward is the recurrence and growth of more

Pat Langdon, Jonathan Lazar, Ann Heylighen, and Hua Dong (Cham: Springer International Publishing AG, 2018), 251–62, DOI: https://doi.org/10.1007/978-3-319-75028-6_22.

30 For project details and publications on The Health and Care Infrastructure Research and Innovation Centre, please visit http://haciric.org/our-projects/design-for-flexibility-and-change-within-health-service-providers/.

31 "Goal 3: Ensure Healthy Lives and Promote Well-Being for All at All Ages," United Nations Strategic Development Goals: Health, accessed November 8, 2018, https://www.un.org/sustainabledevelopment/health/.

32 Nick Dunn, Paul Cureton, and Serena Pollastri, *A Visual History of the Future* (London: Foresight Government Office for Science, Department of Business Innovation and Skills, 2014), available at https://www.gov.uk/government/publications/future-cities-a-visual-history-of-the-future.

33 Ibid., 126.

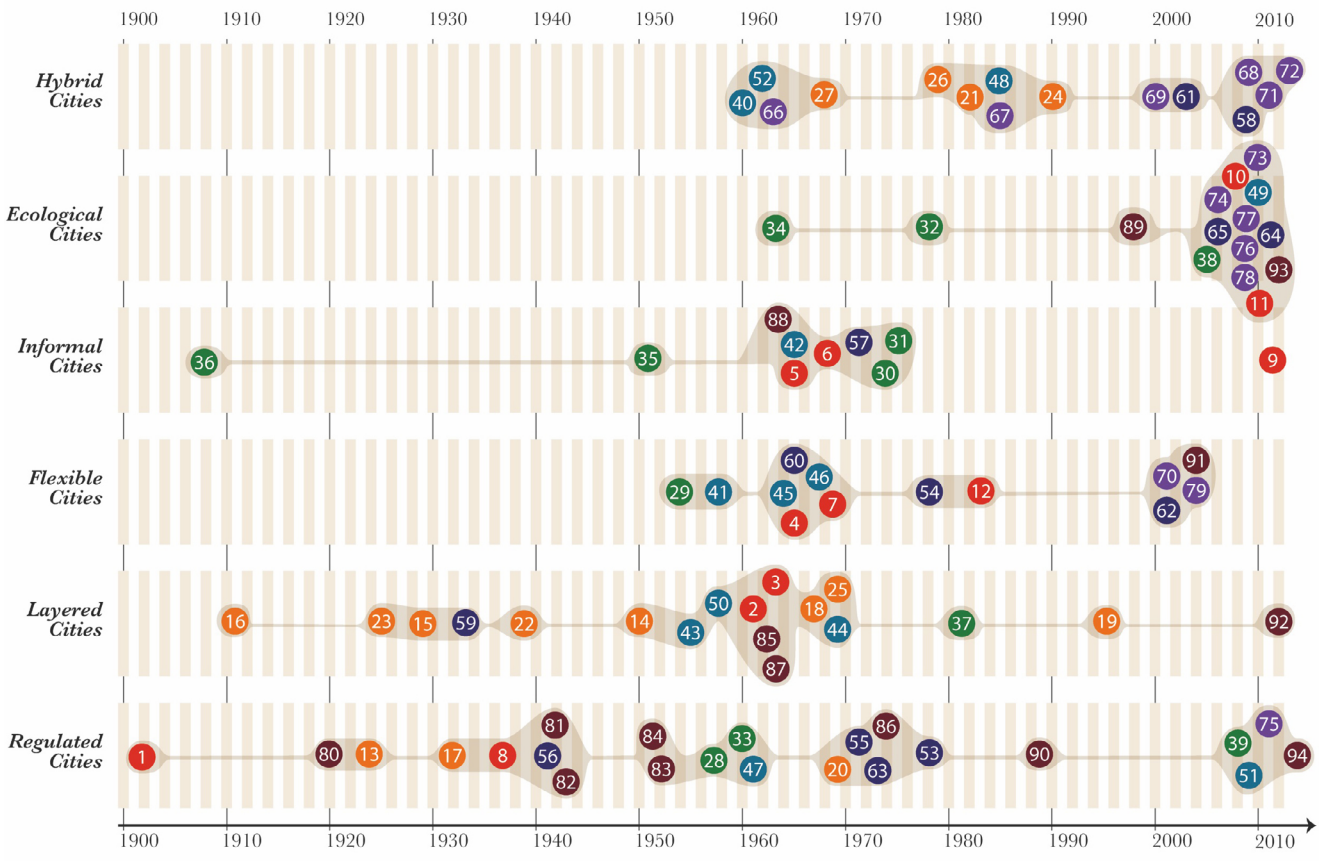


Figure 10 Timeline of the six principal paradigms and twenty-eight future city categories from 1900–2014, from *A Visual History of the Future*. Copyright © 2017 ImaginationLancaster.

socially engaged future city visions in the early twenty-first century. This is perhaps reflective of greater societal and global ambitions for ecological and social sustainability beyond the political, social, and economic infrastructure that cities support. The report informed the UK government's thinking about urban futures – visioning is now a key component of its foresight process. At a national level, the report led to the implementation of visioning workshops with local governments and cities, numerous keynotes and public lectures, and further reports for the government and Ministry of Defense. Internationally, the work led to advisory roles on the European Union Policy Lab Foresight team and the World Health Organization Western Pacific Region Alliance for Healthy Cities.

Our urban design research has been widely acknowledged for its originality and influence, which attests to just how well the research environment at Imagination can generate and support innovative work.[34] Two further examples demonstrate this. The monograph *Dark Matters*,[35] which suggests a novel approach to envisioning the nocturnal experience of cities, has been embraced by the international lighting community and across the UK. Finally, our own Rachel Cooper and Cary Cooper and their colleague Elizabeth Burton from the University of Warwick produced an edited volume on well-being and the environment[36] that brought together an international group of social scientists to address the state of the science for use by designers and policymakers in urban design. Examples such as these evidence the transformative urban design research we conduct that is directly impacting upon places, whether those already built or those yet to exist.

Case Study: Liveable Cities

Liveable Cities was a 5-year, £6.3 million, EPSRC-funded project that concluded in December 2017. The vision was to transform urban engineering practices in ways

34 An interesting example of a recent publication is Serena Pollastri et al., "Envisioning Urban Futures: From Narratives to Composites," *The Design Journal* 20, no. sup1 (2017): S4365–77, DOI: https://doi.org/10.1080/14606925.2017.1352933.

35 Nick Dunn, *Dark Matters: A Manifesto for the Nocturnal City* (Alresford: Zero Books, 2016).

36 Rachel Cooper, Elizabeth Burton, and Cary L. Cooper, *Wellbeing: A Complete Reference Guide, Vol. II: Wellbeing and the Environment* (Chichester: Wiley-Blackwell, 2014).

Figure 11 Working with urban stakeholders to visualize future cities during a Liveable Cities workshop. Copyright © 2018 ImaginationLancaster.

that will deliver global and societal well-being via low-carbon living and resource security. Four universities worked together: Lancaster University, the University of Birmingham, the University of Southampton, and University College London. In total, over 60 academic staff, researchers, and PhD students from the universities were engaged with a number of timely research themes relating to cities, including well-being, energy, policy and governance, economics, future visions, and city performance. Rachel Cooper led the Imagination team, which included Imagination colleagues Nick Dunn, Chris Boyko, Stephen Clune, Serena Pollastri, and Claire Coulton. The team worked on two themes: well-being and visions for the future.

For the well-being portion of the research, we were interested in understanding how urban well-being and walkability are impacted by two characteristics: density and deprivation. We chose to conduct our research in four neighborhood types – (1) low density, low deprivation; (2) low density, high deprivation; (3) high density, low deprivation; (4) high density, high deprivation – within the UK cities of Lancaster, Birmingham, and Southampton. We first distributed a well-being questionnaire to residents of the four neighborhood types in each of the three cities, and then undertook audits of each neighborhood to assess how walkable they were. From an analysis of over 250 questionnaires and 31km of audited roads, we found that low density, low deprivation neighborhoods ranked highest in well-being; high density, low deprivation neighborhoods have the best walkability; and low density, high deprivation neighborhoods rank lowest for well-being and walkability.

We concluded that if town planners and urban designers wish to improve well-being and walkability in UK cities, they must focus on low density, high deprivation neighborhoods and consider ways for design to improve these places through a better mix of relevant uses, promoting active and healthy lifestyles, and facilitating mobility more generally.[37]

For the future visions portion of the research, we were interested in exploring visions for life in future cities. Instead of bringing a diverse collection of people together and running a focus group, we facilitated a series of eight workshops with people from different sectors of activity, including education, IT, transport and utilities, science and environment, heritage, and retail, and put them together with architects, urbanists, and ageing researchers. We used a combination of hands-on design activities and open discussion, which enabled deep, creative thinking in a short timeframe (see Figure 11).

While some groups were interested in specific issues related to cities of the future – the transport and utilities professionals tended to focus on efficiency, for example – there were other issues common to many of the sectors: creating community spaces, equality and inclusiveness, designing digital tools to live in the city, and developing new models of consumption.

From these workshops, we created an *Atlas of Imaginary Future Cities* (Figure 12). The atlas, available online,[38] provides more information about the findings.

37 Christopher Boyko, Rachel Cooper, and Cary L. Cooper, "Measures to Assess Well-Being in Low-Carbon-Dioxide Cities," *Proceedings of the Institution of Civil Engineers—Urban Design and Planning* 168, no. 4 (2015): 185–95, DOI: https://doi.org/10.1680/udap.14.00029.

38 The atlas was the basis for Dr. Serena Pollastri's PhD thesis. Please visit http://seremiru.com/Atlas/export/index.html to experience it firsthand.

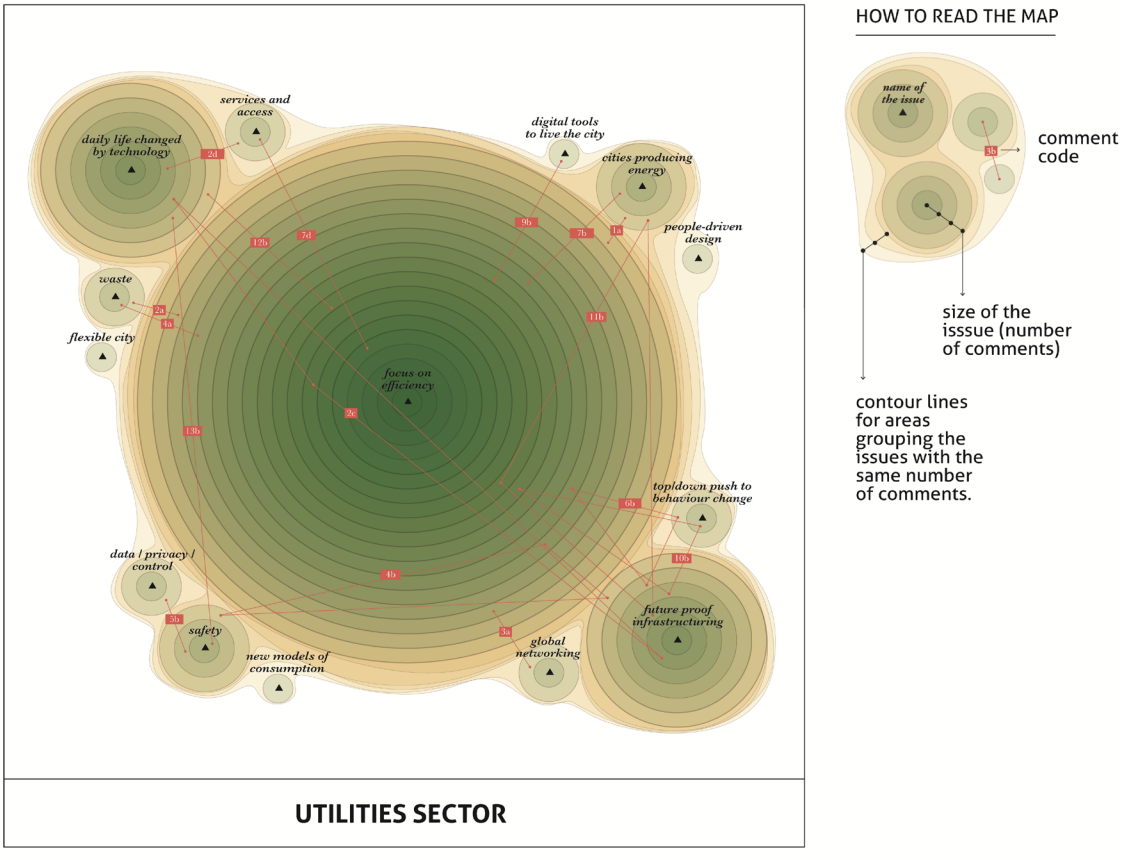


Figure 12 (Above) Image from the *Atlas of Imaginary Future Cities* by Serena Pollastri. Copyright © 2018 ImaginationLancaster.

Figure 13 (Below) Visualization of the findings from the *Future Visions* workshop with utilities sector experts. This image is part of the *Atlas of Imaginary Future Cities*, by Serena Pollastri. Copyright © 2018 Imagination-Lancaster.

For *Liveable Cities*, we used design thinking processes and visualization techniques to bring together the findings from the scientists involved in the work. These tools enabled us to clarify the complexity and interdependencies among the various findings and enabled us to depict these in diagrams such as the one found in Figure 13.

Design for Manufacture

Imagination's Dan Richards leads the group's Design for Manufacture research. The work takes place in response to the increasingly important role that many expect digital technologies, such as additive manufacturing – including 3D printing – the

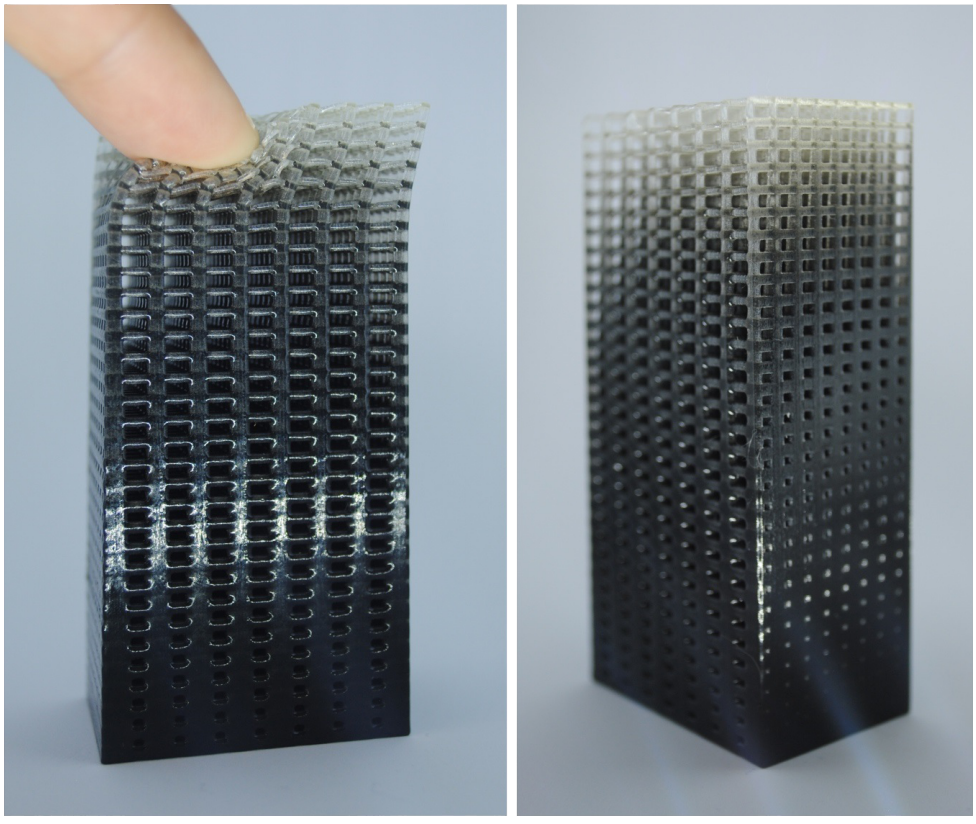


Figure 14 Functionally graded lattice structure composed of ~900 million individual dots of material to produce a seamless blend in a range of forms from flexible and transparent plastic to rigid opaque plastic. Copyright © 2018 Imagination-Lancaster.

Internet-of-Things (IoT), artificial intelligence, and robotic fabrication systems will play in future manufacturing industries.[39]

Richards argues that the big challenge for designers is that traditional computer-aided-design (CAD) tools and practices were simply not created with these technologies in mind. As a result, today's designers, engineers, and artists desperately require new tools and creative practices that allow them to move beyond the limitations of today's CAD packages so they can realize the potential of these new digital technologies.[40] This is no trivial challenge – it is inherently interdisciplinary and demands creative insights from design research.

With this in mind, Richard's approach is to imagine, prototype, and test new kinds of human-data interfaces as a means of unlocking new design and digital manufacturing possibilities. For example, working in partnership with Stratasys Ltd., (a global additive manufacturing company) as part of the Voxel Print Research Program, he has been investigating data-driven tools for designing and manufacturing complex 3D printed objects with seamless material properties (Figure 14).[41] This work explores how the process of designing and constructing objects from literally hundreds of billions of dots – similar to many small pieces of Lego – can enhance the design of a range of physical products. Importantly, whilst this interdisciplinary approach relies on technical innovations to test new ways of digitally representing and communicating 3D designs to fabrication technologies,[42] his primary goal is to investigate expressive visual languages and interfaces that allow designers to maximize creative engagement with digital manufacturing technologies.

Case Study 4: Chatty Factories

This project builds on the rapid growth of the third revolution bringing data, artificial intelligence, and robotic fabrication systems to the forefront of the manufacturing industry. Current manufacturing systems are characterized by a multitude of interconnected procedures that include many discrete, highly specialized and

39 For example, see Foresight, *The Future of Manufacturing: A New Era of Opportunity and Challenge for the UK: Summary Report* (London: The Government Office for Science, 2013), available at https://www.gov.uk/government/publications/future-of-manufacturing; "Made Smarter Review," UK Department for Business, Energy & Industrial Strategy, last modified November 1, 2017, available at https://www.gov.uk/government/publications/made-smarter-review; Wei Gao et al., "The Status, Challenges, and Future of Additive Manufacturing in Engineering," *Computer-Aided Design* 69, (December, 2015): 65–89, DOI: https://doi.org/10.1016/j.cad.2015.04.001; Achim Menges, Bob Sheil, Ruairi Glynn, and Marilena Skavara, eds., *Fabricate: Rethinking Design and Construction* (London: UCL Press, 2017).

40 Daniel Richards and Martyn Amos, "Designing with Gradients: Bio–Inspired Computation for Digital Fabrication," in *Proceedings of the 34th Annual Conference of the Association for Computer Aided Design in Architecture*, ed. David Gerber, Alvin Huang, and Jose Sanchez (Cambridge, ONT: Riverside Architectural Press, 2014), 101–10.

human intensive activities, such as consumer research, concept design, engineering design and prototyping, and manufacturing operations that combine robots with human workers on the factory floor. Two significant limitations of current manufacturing systems are (a) an inability to quickly and continuously refine product design in response to real-time consumer insights – in other words, how people use the product and experience it in the world – and (b) an inability to quickly reconfigure and reskill the human and robotic production elements on the factory floor in response to real-time data captured from embedded product sensors. For example, if sensor data suggests a product needs a design change based on its current use, how do we update the fabrication instructions and reshuffle the factory floor between shifts, and tell human and robot workers how to alter their duties within minutes?

This three-year Engineering and Physical Sciences Research Council funded project has just begun, with Dan Richards leading Lancaster's contribution. It will take advantage of the rapid growth of IoT technologies and data generated by everyday items that 'talk' to each other and transmit massive amounts of useable information. By embedding sensors into everyday products, the goal is to create one seamless design and manufacturing process capable of continuously changing products based on user data. Firstly, mindful of the potential disruption to labor markets, we will develop new fundamental theory that relates to learning and seamless communication between products, humans, robots, and factory floor operations, to ensure equality and collaborative real-time learning. Secondly, we will develop data-driven design systems that provide an auditable, secure, seamless flow of information between all operations inside and outside the factory to facilitate real-time adaption and re-orientation of the entire manufacturing system based on data harvested via product-embedded sensors and IoT connectivity.

Design for Communities

Since the beginning of Imagination, we have sought to help others use design for positive change. At the same time, we have been interested in the notion of open innovation, co-design, and participatory design – exactly what they are, what they mean, and how they are conducted. We have pursued this work through a series of major UK and EU research projects. For example, the project *Beyond the Castle* worked with over 2,000 local people to reimagine an 800 m² space in the center of Lancaster city, in England's northwest. The project was part of the €5 million EU funded *PROUD* project. It was significant practically, because it set the agenda for how the space would be developed for at least the next 10 years, challenging the assumptions of the land owners. The project also created a "beyond the castle" community from a diverse range of users of the space. This group is still active, stable, and funding its own activities externally five years after the academic project was completed. Finally, the new types of engagement the project fostered changed the way the city council engaged with people. As one council officer put it, "Through the *Beyond the Castle Project* we found a new way to trust people." The council now has the tools and confidence to enter into real dialogue with their communities. This three pronged outcome – tangible benefits, resources for further positive outcomes, and changes to process – is at the heart of what designers can offer when co-designing with communities.

Case Study 6: Leapfrog

Leapfrog, led by Leon Cruickshank, was a £1.2 million Arts and Humanities Research Council funded research project whose aim was to transform public sector engagement in the UK. The demand for wider public engagement in decision making at all levels has increased at the community level as well as through statutory

41 Daniel Richards, Tom Abram, and Allan Rennie, "Designing Digital Materials with Volumetric Gradients" (paper presented at RDPM2017: the 15th Rapid Design, Prototyping & Manufacturing Conference, Newcastle, United Kingdom, April 2017), 27–28, available at http://www.research.lancs.ac.uk/portal/en/publications/designing-digital-materials-with-volumetric-gradients(91314f05-df64-4cea-bf0d-3a0a2e25b2a7)/export.html.

42 Daniel Richards, Surface Modelling, US Patent Publication no. WO/2017/153769, International Application no. PCT/GB2017/050647, published September 14, 2017, patent pending; Daniel Richards and Martyn Amos, "Shape Optimization with Surface-Mapped CPPNs," *IEEE Transactions on Evolutionary Computation* 21, no. 3 (2017): 391–407, DOI: https://doi.org/10.1109/TEVC.2016.2606040.

requirements, but the funding available for engagement activities has plummeted in the UK and elsewhere. Led by Imagination, with Glasgow School of Art as partners, the *Leapfrog* project developed new engagement approaches, tools, and resources to make engaging with members of the public more effective and innovative. We achieved this by co-designing them with groups of public sector workers and other stakeholders. A crucial aspect of *Leapfrog* was that these public sector co-designers took ownership of the things that they developed. To do this, they identified issues critical to their engagement practice and then together designed and implemented solutions to these issues. The solutions were tailored to suit their needs and directly beneficial to them but could also be adapted and shared widely. Through five major interventions and 15 more tactical short projects, we developed 50 new tools and resources for innovative engagement, all of which are freely available from the project website.[43] They are quite flexible – for example, each tool's textual content can be edited to suit the needs of anyone who chooses to download it.

One of the major projects *Leapfrog* undertook focused on engaging with young people (Figure 15). We approached this by collaborating with three sets of relevant stakeholders. The first set was comprised of engagement officers who had worked with children in the past, but only intermittently – so they were not used to working with teenagers, for example. The second set was a group of policy makers. The third was made up of young people that were in the care system or in danger of being placed in care (perhaps because they had been taken away from their biological family for a safeguarding reason). Co-designing with the young people was extremely challenging. Working very closely with the charity Child Action Northwest and the local council Safeguarding Officer, we designed several workshops to help the youngsters, aged between 13 and 17 years old, to co-design. The result was a series of tools that helped them connect more effectively with the social care system and a newspaper describing their activities and the tools. The project received the British Youth Council's prestigious "Youth on Board Award" for innovation in 2016 – this is notable because young people were entirely responsible for the selection and judging process for the award.

Figure 15 Some of the young people from the *Leapfrog* project (above), and Leapfrog's Target Control tool adapted to hear the voice of an 8-year-old girl in the decision making process during a custody hearing (below). Copyright © 20108 Imagination-Lancaster.

This is but a small fragment of activity from the first Leapfrog project. Leon Cruickshank has recently received further funding for *Extending Leapfrog: Improving a Million Creative Conversations*, which began in November 2018.

Design research creates the scaffolding or support that enables non-designers in the public sector to be creative in their own way – which is often very different to the way designers are creative – and use their creative contributions to develop tools and resources that in turn help other people. In this way design can open the creative potential of others and achieve this at scale with limited resources.

Design for Society

Designing for complex urban systems and structures is increasingly reliant upon data – including personal data – that organizations and individuals routinely collect, process, and share as part of everyday life. Data now play a role in health care,

43 For more information, and to download the tools, please visit http://www.Leapfrog.tools.

communication, energy use, consumption, mobilities, and risk assessment and disaster management. Datafied[44] research and innovation presents the promise of richer awareness and service management; new ways to conduct predictive analysis; more agile response capacity; coordination of time-critical, distributed multi-agency operations; and more targeted communications with the public. Innovation in this domain is transformative; it is changing from authoritative, publicly funded forms of command and control to increasingly data-based, net-centric approaches involving monitoring and surveillance of people, assets, and environments. Complex ethical tensions arise between fundamental human rights and the drive to innovate for better public preparedness.

Research and innovation in this domain is struggling to address these tensions proactively, partly because knowledge is fragmented through sectors, cultures, and countries, and partly because the challenges are formidable. For example, costly cybersecurity failures occur because socio-technical innovation happens so fast that people struggle to understand the need to adopt even the simplest security measures into their everyday practices. This holds back positive organizational, social, and technical change, and ultimately socio-economic development and democracy—undermining trust in public institutions and cross-border collaboration at a time when crises are increasingly transnational.

Case Study 7: Is IT Ethical? Ethics in Crises

Imagination's Male Lujan Escalante is co-investigator on this project, alongside Monika Buscher from Lancaster's Centre for Mobilities Research. The project *Is IT Ethical?* is developing ethical, legal and social implication (ELSI) guidelines in active collaboration with practitioners, industry, and policymakers in the European Union. Our partners and networks agree that a firmer grasp of ELSI opportunities and challenges is needed. The proposed convergence of existing efforts has the potential to embed responsible advanced research and innovation strategies in real world practice and industrial R&D in concordance with civil and human rights.

ELSI cannot be uniformly defined for all situations, and it is not possible to provide strict protocols, codes of conduct, rules, or step-by-step instructions. Instead, the aim is to promote creative and reflective conversations on responsible scientific and technological innovation, including foresight into ELSI, specifically focusing on beneficence and human rights. There are myriad practice codes, legislative measures, and normative guidelines, but they are specific to one sector or one country or focused only on design or management, neglecting that today's digital technology use is characterized by interconnected social, economic, political, cultural, and organizational complexities enfolded into it at every level of use (Figure 16).

Is IT Ethical? is in the process of designing and developing digital-physical exercises to foster these encounters among key EU stakeholders. Highly context-specific ELSI guidelines have already been developed during a four-year EU funded project called *SecInCoRe*.[45] At Imagination, in collaboration with The Centre for Mobilities Research, we are working on building creative and playful ethical exercises using the *SecInCoRe* ELSI guidelines, to approach discussions in the context of Brexit and also in relation to IoT, drone, and predictive analytics technologies integration into the disaster risk management and emergency response sector.

44 ***Datafication*** **refers to the practices of generating (through use), gathering, processing, and otherwise quantifying personal and other data obtained via today's digital tools, devices, and platforms. See Viktor Mayer-Schönberger and Kenneth Cukier,** ***Big Data: A Revolution That Will Transform How We Live, Work, and Think*** **(New York: Houghton Mifflin Harcourt, 2013), 73–97.**

45 For more information, please visit http://www.secincore.eu/.

Figure 16 ***Is IT Ethical?: The Board Game*****, a tabletop ethical assessment exercise exploring technological governability and interoperation in common information spaces across Europe. Copyright © 2018 Imagination-Lancaster.**

Design Futures

Increasingly, the products and services created by designers are conceived, produced, and ultimately operated digitally. Riding this powerful wave of digitization, the designed world can at times feel like we are passengers hurtling towards some near future horizon. Designers not only play their part in fuelling the engine that drives this acceleration but also in preparing humanity for the futures that await us just over the horizon. At Imagination, rather than preparing people for specific futures, we have been at the forefront of developing new ways of allowing futures to be explored and challenged so that they can encompass a plurality of different views.[46] In particular, we have sought to move beyond the traditional use of scenarios by using speculative design and particularly design fiction to create worlds through which we can present emerging technologies that are situated[47] as mundane parts of our everyday future lives.[48] These imaginaries – to borrow Charles Taylor's term[49] – form a conceptual bridge from the present to some plausible future in which certain emerging technologies have been domesticated.

Case Study 8: PETRAS

The Privacy, Ethics, Trust, Risk, Adoption, and Security of the Internet (*PETRAS*) project is a £10 million Engineering and Physical Sciences Research Council (EPSRC) and Department of Culture Media and Sport project. The Imagination team, headed by Paul Coulton and Rachel Cooper, are working alongside engineering and computer science colleagues at UCL, Imperial, Warwick, Southampton, Surrey, Cardiff and Edinburgh Universities. IoT – both as a term and as a phenomenon – has expanded rapidly. It now encompasses a variety of domains and applications, from factories to hospitals, cars, homes, wearables … all of which makes it quite confusing. We use the term to describe objects or things that can be interconnected via the Internet. This allows them to be readable, recognizable, locatable, addressable, and controllable by computers.[50] The "things" referred to by the term IoT can be literally anything – a kettle, a door lock, an electricity meter, a toy doll, or a television – and is important to remember that there is no limit on what is or is not an IoT thing. Anything that is connected to the Internet is arguably part of the IoT – including us.

46 Paul Coulton, Dan Burnett, and Adrian Gradinar, "Games as Speculative Design: Allowing Players to Consider Alternate Presents and Plausible Futures," in *Proceedings of DRS 2016, Design Research Society 50th Anniversary Conference*, vol. 4, ed. Peter Lloyd and Erik Bohemia (London: Design Research Society, 2016): 1609–26, available at http://www.drs2016.org/015/.

47 Lucy A. Suchman, *Plans and Situated Actions: The Problem of Human-Machine Communications* (Cambridge, UK: Cambridge University Press, 1987).

48 Paul Coulton, Joseph Lindley, Miriam Sturdee, and Mike Stead, "Design Fiction as World Building," in *RTD2017: Proceedings of the 3rd Biennial Research Through Design Conference* (Research Through Design, 2017), DOI: https://doi.org/10.6084/m9.figshare.4746964.

49 Charles Taylor, *Modern Social Imaginaries* (Durham: Duke University Press, 2004).

50 Paul Coulton, "Playful and Gameful Design for the Internet of Things," in *More Playful User Interfaces*, ed. Anton Nijholt (Singapore: Springer, 2015), 151–73, DOI: https://doi.org/10.1007/978-981-287-546-4_7.

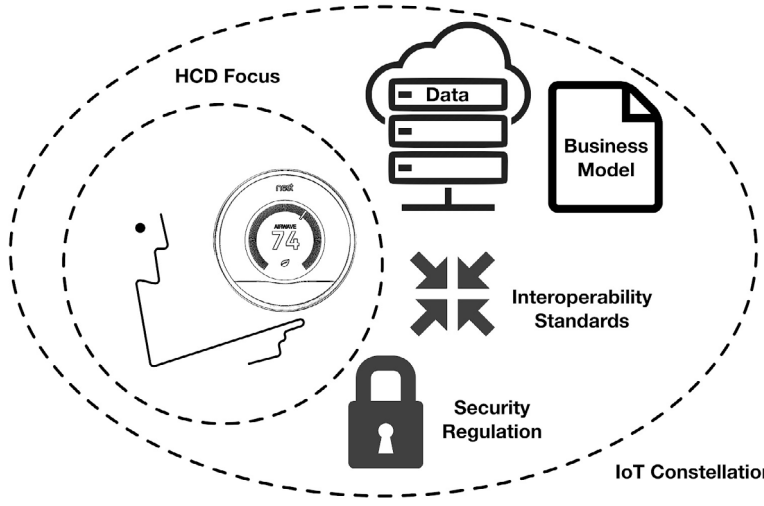


Figure 17 IoT constellation for adopting a more than human centered design approach. Copyright © 2018 Imagination-Lancaster.

Thus to fully understand IoT, you must appreciate there is much more to it than just the things that are visible to you. Other elements exert a significant influence in IoT and are often forgotten. For example, a user might simply see a physical smart thermostat in their home, but behind the scenes there is a data center processing all the information generated by this user's thermostat in addition to the data from all of the other smart thermostats that the company has produced. This data may be linked to third parties who further process the data to understand how people heat their homes. These data are often crucial in terms of the thermostat company's profitability because monetizing the data generates additional revenue that selling thermostats alone would not produce. This business model relies on data interoperability, standards for security, and the use of algorithms to process the data and better enable third parties to use them. Whilst that innocent smart thermostat might be an example of Human Centered Design (HCD)—it provides its functionality to the user in a simple elegant way—its other IoT activities are largely opaque or invisible to the user. When these other activities are broken down in terms of security or privacy, user confidence in IoT can be hugely impacted. In our work for PETRAS we call these interrelated collections of objects, data stores, third parties, business models, and so on "IoT constellations" (see Figure 17). The work, led by Paul Coulton, uses IoT constellations as a design metaphor built on top of object oriented ontology (OOO),[51] enabling us to formulate an approach to the IoT that goes beyond HCD.[52]

To illustrate the use of this metaphor in practice, we adopted a design fiction approach that allowed us to consider how the metaphor might affect future IoT adoption. Although the design fiction approach is increasingly present within design research, there are still lots of competing theories about how best to apply it. Some argue that design fictions are a mans of using science fiction to articulate what it will be like to live with future technologies or influence popular understanding of modern issues like sustainability. Others see design fiction as a way of building narratives that tell stories about the future that enable us to think more carefully about that future. However, in our practice we call it *design fiction as world building*[53] in that design fictions are collections of artifacts that, when viewed together, build a fictional world. The artificially built world is a prototyping platform for the very designs that define it, meanwhile those designs reciprocate in kind and prototype the world.

To explore this notion of IoT constellations, we created a fictional IoT kettle called Polly[54] with a number of features that illustrate the constellation metaphor

51 Graham Harman, *Tool-Being: Heidegger and the Metaphysics of Objects* (Chicago and La Salle: Open Court, 2002).

52 Lindley et al., "Why the Internet of Things," S2846–57.

53 Coulton et al., "Design Fiction as World Building."

54 Joseph Lindley, Paul Coulton, and Rachel Cooper, "Informed by Design" (paper, Imagination Lancaster, Lancaster University, United Kingdom, 2018), available at http://eprints.lancs.ac.uk/125949/1/informed_by_design.pdf.

Figure 18 IoT design fiction Polly displaying various actions and transactions in plain English (left) and volume of data transactions (right). Copyright © 2018 ImaginationLancaster.

(Figure 18). Using it demonstrates to users how IoT devices demand/require their consent to a variety of data transactions – with Polly, users provide data in exchange for the device's functionality. To grasp this transactional arrangement, the user must understand which data the kettle collects, when it does so, why, and what it does with them. Polly's visible use timeline lets users view every time the kettle takes part in a data transaction. There is a simple visual key that tells the user whether the transaction involved uploading, downloading, or moving data around the local network. A plain English name for each transaction tells the user what is happening to the data. For example, the kettle clearly displays that it is uploading data to the cloud when the kettle is removed from its base and when the water is refilled. In contrast, when the kettle gets a boil request, that information stays within the local network.

The design fiction as world building approach we have developed at Imagination is both flexible and accessible. It allows different artifacts within the design fiction to engage a diverse audience – users, corporations, governments, and more – and stimulates questions relating to the socio-technical futures emerging technologies might instigate.

Design Research and Education: The Intersection

Our philosophy and approach to design education is that teaching must be research and expertise led. Traditionally, design was taught as a "sitting-with-Nellie"[55] experience – the master leads the students – with professional designers. However, as design has matured as a scholarly discipline, and design research has increasingly informed our understanding of its relationship with the material world, we believe that academics with advanced research and practice experience are pushing the boundaries of knowledge in design. Thus, our programs are design research informed and led by our academic staff, all whom have PhDs and extensive research experience. Our programs incorporate design skills and professional practice to inform future thinking and experimentation so our students will be thought and practice leaders in the application of design to global challenges.

Our curriculum and program development is top down, research led (see Figure 4). We start with our research, and ask, "What is next on the horizon? What new insights do we have after exploring issues through our undergrad and graduate education programs?" so that our programs remain leading edge and challenging within contemporary theory and practice.

55 Oxford Reference, s.v "sitting-with-Nellie," accessed November 8, 2018, http://www.oxfordreference.com/view/10.1093/oi/authority.20110803100509169.

Unique Funding for Unique Research

Within the context of out doctoral research programs, we have sought a wide range of funding created three transverse research programs that each bring together a diverse group of actors and stakeholders, undertaking new approaches to research to address a diverse range of challenges.

HighWire

HighWire was a doctoral training center that took a post-disciplinary approach to innovation through research and crossed the domains of computing, design, and management. It was funded by the UK Engineering and Physical Science Research Council. It supported 50 doctoral students from 2010 to 2015. Each year we recruited from ten to twelve exceptional students interested in working at the intersection and beyond the disciplines of computing, design, and management. Our *HighWire* students were expected to perform research focused on problems, not disciplines, in collaboration with world leading commercial partners. The program duration was four years, and included a master of research plus a PhD. The aim was to understand and apply innovation to the digital economy and exceed traditional multi-disciplinary approaches by seeking a creative fusion between the program's three key disciplines. The overall emphasis was on producing a new breed of innovative people who understood and were able to advance the state of the art in technical, design, and business innovation.

Creative Exchange

The Creative Exchange (CX) was a knowledge exchange hub, funded by the Arts and Humanities Research Council, which explored the creative digital economy where anyone can access, explore, and create content anywhere and at any time. Between 2012 and 2016, Imagination led a partnership between itself, the Royal College of Art, and Open Lab at Newcastle University. Each institution had funds to support seven doctoral students and a research fellow. This group of students formed a unique cohort who worked together with academics from other universities and with businesses and communities across the public and private sectors. Their PhDs grew out of creative exchange events co-created with these partners. The partnerships explored creative applications for digital media and technology to address the social and cultural challenges facing organizations and communities across the UK; they had economic, social, and cultural impact.[56] Figure 19 shows the CX model we

56 To learn more about the outcomes from the *Creative Exchange* project, please visit http://thecreativeexchange.org/#/outcomes.

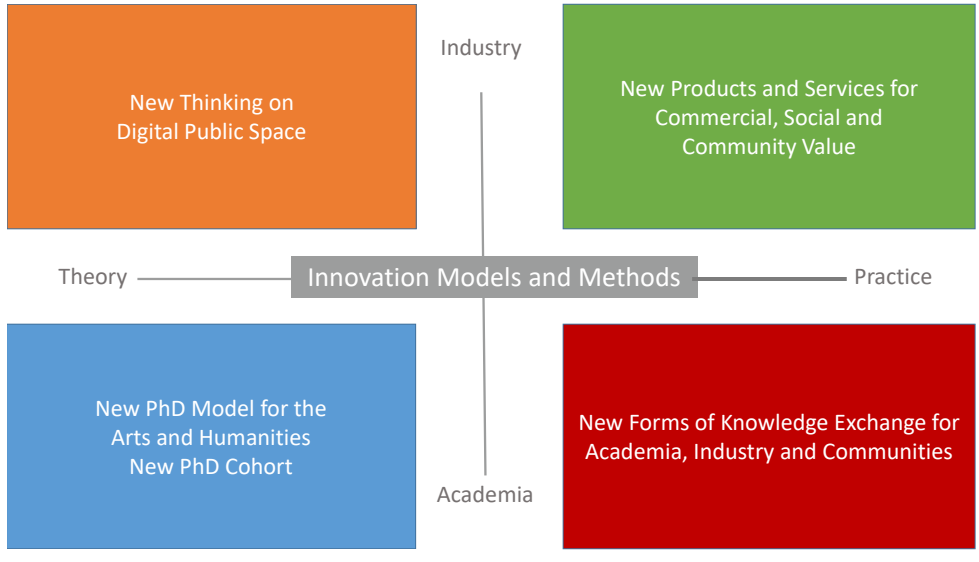


Figure 19 Visualization of the Creative Exchange method. Copyright © 2018 Imagination-Lancaster.

developed to illustrate our approach. The Creative Exchange had funds to invest in over 90 projects, connecting over 100 organizations, 150 university academics, and producing a cohort of 21 PhDs skilled at bridging academia and industry. Many of the projects resulted in new products and services. In total, the CX Hub developed and piloted concepts and prototypes for 61 artistic and creative products and 42 software and technical products.[57]

Red Ninja

To offer you a concrete example of the impact that CX projects created, consider the testimony of Red Ninja, a Liverpool-based, design-led technology company. They collaborated on the *Open Planning* project alongside Liverpool University academics, Liverpool City Council, and two CX doctoral researchers. They defined themselves at that time as "a bootstrapped tech start up with 3 staff and little track record of working directly with local authorities and universities."[58]

The *Open Planning* project worked across the public and private sectors to develop an innovative app enabling wider public engagement with the urban planning process. Its participation in the project caused significant shifts in Red Ninja's business practices and in their approach to collaborative work. In CEO Lee Omar's words,

> "Having direct access to a local authority in a paid capacity gave us confidence and credibility, which enabled us to design and develop a solution that enables more visibility for citizens living in urban environments.
>
> The Creative Exchange process was fantastic for us … we invested a lot of our own time into the project and were able to produce IP that we could commercialize. By learning to work with the city's open datasets as part of the Creative Exchange, we were able to design and develop commercial products with a multinational energy company for a smart energy platform enabling sustainable urban development. Commercially, this was extremely valuable to us and validated the extra work we did on the Creative Exchange project."

Since engaging with CX, Red Ninja has taken on five times its original number of staff and their turnover has increased sixfold. The company has chosen to maintain a collaborative approach to its work – it sponsors a PhD program embedded within its practice and is developing its own research department.

Additionally, as a direct result of what they earned during the Open Planning project, CX funded a twelve-month collaboration to develop a new platform for councils, as data holders, to return data to relevant parties in truly open and beneficial ways. It involved working with current data handling companies to develop a new system, with the aim of scaling it across the country. The platform was tested in three cities: Manchester, Lancaster, and Liverpool.

Transformation North West

Transformation North West (aka *Transformation NW*) is a fully-funded doctoral training program that applies design and creative techniques to maximize new product and service opportunities for businesses in North West, UK. Starting in 2017, the students have begun to co-create a program of applied research in collaboration with large and small businesses. Building on research expertise in design, digital technologies, and the creative sector across five core partner institutions (Lancaster, Manchester, Manchester Metropolitan, Liverpool, and Salford Universities), innovative cooperation and collaboration across the entire consortium will help all to generate new product and service opportunities for businesses in the North West. Adopting an open and cross-industry approach, students will fuse science and technology with creative techniques, integrating place- and thematic-based responses

57 The final report for the *Creative Exchanges* project is available at http://thecreativeexchange.org/#/reports.

58 Comments by Lee Omar (CEO of Red Ninja), cited in Rachel Cooper, "The Creative Exchanges Final Report to the AHRC," 43, available at http://thecreativeexchange.org/#/reports.

to foster conditions for a sustainable, resilient, and inclusive local economy. The first three months saw all twelve students research together the creative and digital sector in the North West of England. Their efforts resulted in the publication of a joint report that was used as a basis for the development of their industry projects.[59] Transformation NW aims to further grow and scale the creative sector in the North West whilst enhancing and contributing to industry more generally, with the understanding that much of the economy increasingly relies on the combination of science, technology, design, and creativity.

Our Education

PhD Programs

As discussed earlier in this paper, Imagination began as a top down organization – we built the research programs and environment first, and then the PhD, master's, and undergraduate programs. We have since focused extensively on developing innovative PhD programs. We work with candidates who come from all over the world, at any point in their careers, to study for a PhD in their area of interest. We match them with supervisors whose skills and knowledge will support the completion of their research program. And they form strong ties with a group of doctoral students undertaking a similar journey.

Yoori Koo, our first PhD case study subject, joined us from South Korea to undertake her PhD in Design Management.

PhD Case Study 1

Yoori Koo: A Design Management Approach for Supporting the Delivery of Corporate Social Responsibility (CSR) with Special Reference to the Electronics Industry

For her PhD, Yoori Koo (now assistant professor at Hongik University, South Korea) analyzed corporate designers' experience integrating socially responsible design (SRD) to investigate how best to incorporate corporate social responsibility (CSR) thinking into design and use it to deliver CSR philosophy inside organizations.

She divided her research methodology into three phases: a pilot study consisting of 8 exploratory interviews, a survey, and two in-depth case studies of multinational electronics companies involving interviews with over 40 designers. The survey results empirically validate the complexity of SRD decision-making by depicting two important factors related to SRD decision making: designers' personal knowledge of CSR, and the organization's regulatory efforts to achieve its CSR goals (see Figure 20). The results also identify four different ways in which designers think about CSR along with four different levels of organizational SRD decision making. The survey results revealed that the link between firms' design management capacity and SRD performance is much stronger than the one between individual awareness of CSR-related issues and their perceived performance of SRD. The findings of the case studies identified a total of 27 topics that may be associated with socially responsible design thinking within the organizations, either directly or indirectly. The research resulted in a series of recommendations aimed at developing a design management approach that enables the realistic implementation of CSR principles in the new product development process – the "Socially Responsible Design Management Initiative (SRDMI)."

In addition to our individual students, we have students attached to certain research programs, including *Liveable Cities*[60] and *PETRAS*.[61] They join not only the doctoral cohort – they also undertake a directed program of work relevant to the research project. For instance, the work of Serena Pollastri (now a lecturer at Imagination) formed a critical part of the *Liveable Cities* program.

59 Transformation North West, *Driving Industrial Strategy for North West Growth: The Role of the Creative Industries* (Lancaster: Imagine Lancaster/ Lancaster University, 2017), available at https://transformationnorthwest.org/wp-content/uploads/2018/06/2018_TNW_Driving_Industrial_Strategy_for_North_West_Growth.pdf.

60 For more information about the *Liveable Cities* project, please visit http://liveablecities.org.uk/.

61 For more information about the *PETRAS* project, please visit https://www.petrashub.org/.

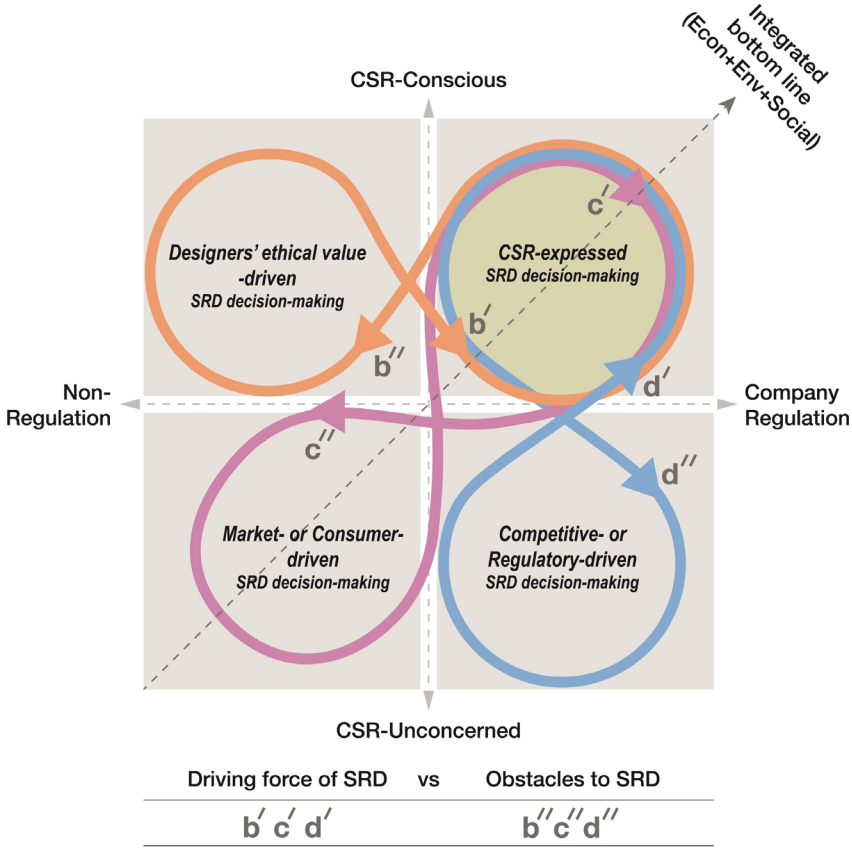


Figure 20 The dynamic two dimensional model of SRD decision-making. Copyright © 2018 ImaginationLancaster.

PhD Case Study 2

Jeremy Davenport: CX Blood Data Visualization

Jeremy Davenport's CX PhD explored the question of effective knowledge transfer and knowledge exchange in relation to how data are presented to patients on an online platform. The project's immediate objective was to explore and evaluate different creative options for improving how data are visualized in support of patient engagement and understanding. This objective reflected Davenport's proposition, born of his experience, that the way data are currently visualized may be a barrier to knowledge sharing. At a strategic level, the project identified factors that contribute to successful knowledge exchange/sharing outcomes in relation to these key metrics, especially patients' awareness of their own blood levels of phosphate and potassium and whether these levels were within the acceptable range for their diagnosis. An awareness and understanding of this information provides the basis for discussion, guidance, negotiation, and collaboration between patients and dieticians exploring actions that may improve medical conditions (improved outcomes may be a combination of diet and medication). A further dimension of the project explored creative solutions for generating digital spaces that enable patients to provide feedback on how they feel, both physically and mentally, at different points in the dialysis cycle. This feedback loop is currently lacking on the PatientView[62] online platform and has been cited by medical staff as an underdeveloped area of renal care. The project resulted in the development of an app and a wraparound service that is currently being tested by the NHS in North West England.

62 PatientView is an online platform for UK patients to manage their health data. For more information, please visit https://www.patientview.org/.

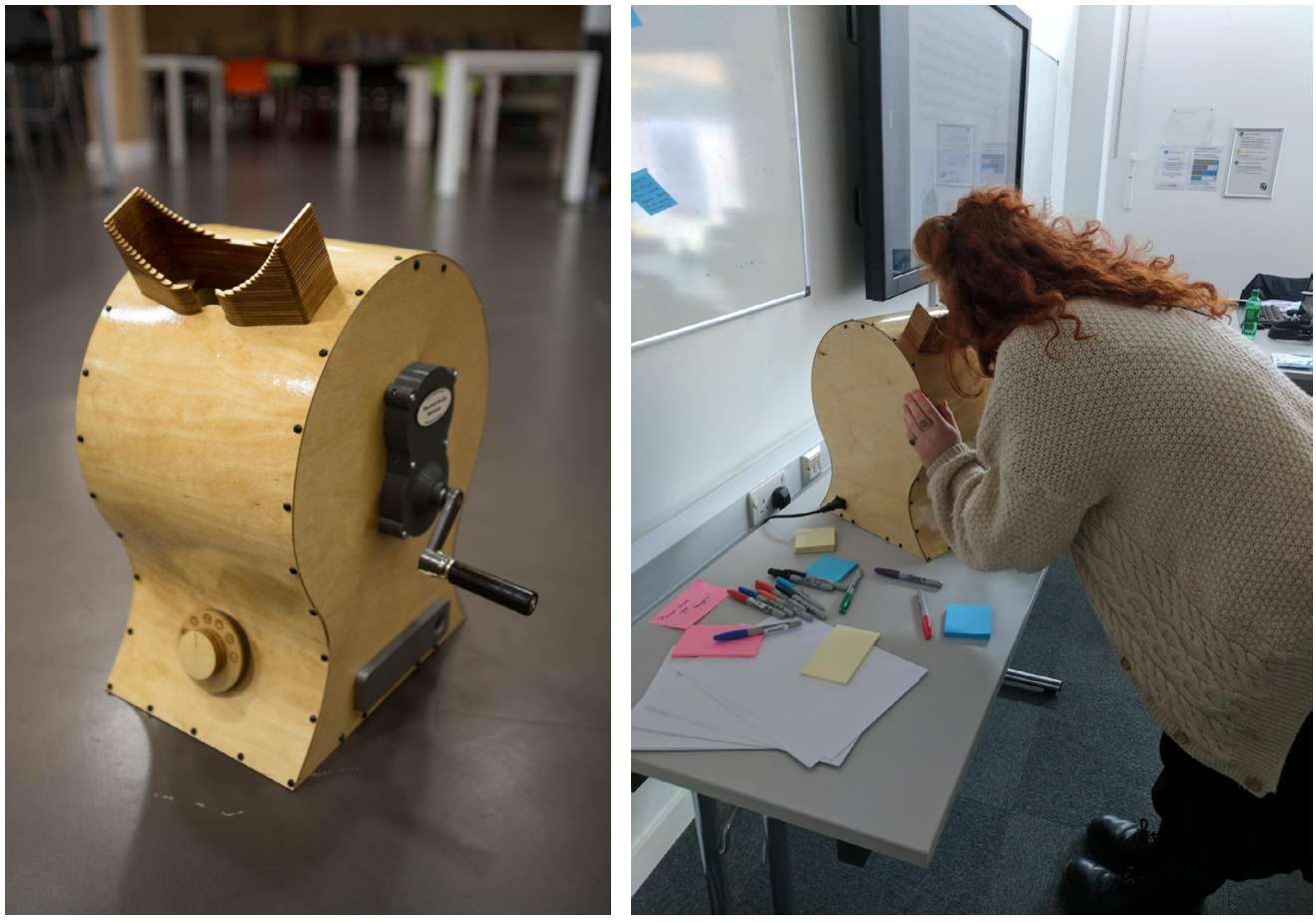


Figure 21 The Physical Social Network (left); user testing of the Physical Social Network (right). Copyright © 2018 ImaginationLancaster.

PhD Case Study 3

Adrian Gradinar: Designing Interactive Objects and Spaces for the Digital Public Space

In the words of Adrian Gradinar,

> "The AHRC Creative Exchange research project set to explore the myriad potentials in the Digital Public Space, from understanding, facilitation, and creation of digital public spaces to privacy and ethical concerns. I approached this space by considering how our own physicality means that there will always be a tangible aspect to the consumption of digital information – a duality in existence that needs to be understood in order to design better experiences. In particular, I am concerned with the characteristics and particularities around the creation processes involved in the design of mixed-reality objects and spaces which might contribute to the Digital Public Space in the context imposed by the juxtaposition of the digital and the physical worlds."

The consumption of digital visual information is intrinsically related to screens, given that there is no better means to display such content. Interestingly enough, certain screen-based interactions are common to a variety of content: we use a mouse to scroll down through an online gallery, read a blog post, fast forward or rewind a video, navigate a website, and so on. The touchscreen interface has multiplied these shared forms of interaction with the addition of swiping, pinching, and zooming. The same gestures are used, again and again, across different media types and interactions. One might say that today, it is common to adapt content to fit these forms of interaction, rather than designing interactions around the particularities of the content. The *Physical Social Network* project explores such concerns and proposes the use of a physical object – a reader powered by a crank handle – to interact with a collection of digital images (Figure 21). Adopting a research through

Figure 22 The Edwardian Postcard Project/Physical Social Network collaborators. Copyright © 2018 Imagination-Lancaster.

design approach, the final artifact resembles an antique, pleasure pier arcade machine. It allows users to digitally rotate a collection of Edwardian postcards through the use of a physical mechanism (Figure 22).

Master's Programs

MA in Design Management: Defining a New Equilibrium

In 2007, one of the first things the Imagination team embarked upon was the development of a new postgraduate course: the MA in Design Management. It was decided from the outset that the course philosophy would prepare graduates for careers as design consultants, managers, researchers, and design led change makers in private and – importantly – public sector organizations. Design has moved beyond its traditional boundaries – the creation of artifacts and experiences – and is now becoming more widely accepted and valued in diverse contexts such as health care, transport, and public service provision. As such, the team carefully devised a dynamic thematic curriculum that explores design management from a range of future oriented perspectives including service design, design for sustainability, design strategy, and design and branding.

We explore new directions for people, products, services, and systems through program of case studies, live projects, and visiting professionals. The diverse range of contributing experts have broad and in-depth experience in design and design management, and are leaders within their particular fields. In fact, everyone contributing to the course has either written extensively in their chosen area of research and practice or led major research projects alongside multi-agency partners. For example, course leader David Hands was lead investigator for Imagination on the EU funded *Design for Europe* project, which explored the value and role of design throughout Europe, and specifically focused on design for business, design policy development, and design for public good.

The MA in Design Management course considers design management as a vital discipline for both industry practitioners and theorists alike. Its gradual journey towards maturity from 2007 is relentless and carefully orchestrated, with industry practice informing theory and understanding and vice versa. The challenging nature of the curriculum gives rise to an interrelated set of questions: *Who is leading change? Who are the beneficiaries of change? What role can design play in leading this change?*

63 The Liveable Cities Little Book series is available for download at http://liveablecities.org.uk/outcomes/little-book-series.

64 For more information about this project, and to download project documentation, please visit https://acmedsci.ac.uk/policy/policy-projects/health-of-the-public-in-2040.

Undergraduate Teaching

The research team at Imagination has been engaged in undergraduate teaching for over eight years, beginning with joint BSc programs in Marketing and Design and IT for the Creative Industries before adding a single honors BA course in 2014. In 2016 our BA in Design Interactions program was adopted by Lancaster University College at Beijing Jiaotong University and is jointly delivered by Imagination staff, splitting their time between Lancaster in the UK and Weihai in Shandong Province, China.

According to Imagination colleague Roger Whitham, the emphasis of our teaching is on the future and on the integrative role design expertise will play not only in designing new products and services but also in reshaping the way people, products, and places interact. We situate design interactions at the heart of our undergraduate program, and offer our students four diverse, practical studios to explore them:

1. Materials studio, to explore how materials and technology inform and influence the development of design artifacts;
2. People studio, to focus on people as both recipients and potential creators of design interactions;
3. Contexts studio, to consider contemporary issues (ecological sustainability, health, well-being) and wicked problems through the lens of specific contexts (space, place, or practice); and
4. Things studio, to summatively engage students in exploring the potential futures that might result from particular emerging technology—Artificial Intelligence machine learning, robots, diamond batteries, biomimetic materials, and others—through the creation of an artifact (or artifacts) that make those futures concrete.

Accompanying these four core studios are modules on the history of art and design, design thinking, design management, and design innovation. Our intent across all our undergraduate programs is to create a new kind of designer, one capable of engaging with complex challenges that demand not only a wide range of practical and analytical skills, but also the ability to move fluidly between different domains of expertise. Our graduates are equipped to work with products, people, and places in themselves, and with the connections, gaps, and infrastructures between them. These new designers revel in today's social, technology, and business challenges, and in the complex, emergent challenges the world will face in the next century.

The Value of Design Research, and the Future of Imagination

This paper illustrates both our approach to design research by creating a dynamic design research environment and to the challenges we address. It is also clear that we build our education and learning environment around this knowledge exploration and knowledge building. However, it is not enough for design research to influence the academy, the profession, and graduating students. Design researchers must influence wider society and policy. Our approach is to engage with policymakers as much as possible by ensuring our findings are accessible through video and print, and not just published in academic journals. For instance, we produce a *Little Book* series on the results of our research that is accessible to a non-academic audience. We create these *Little Books* as essential guides for non-expert readers. We have a series of *Little Books* for the *Liveable Cities*[63] project and are currently working on another series for the *PETRAS* IoT Hub (see Figure 23).

We also engage with policymaking through national initiatives. Rachel Cooper, Nick Dunn, Paul Cureton, Chris Boyko, Serena Pollastri, and Claire Coulton have

Figure 23 **Covers from *The Little Book of Design Fiction for the Internet of Things*, written by Imagination colleagues Paul Coulton, Joe Lindley, and Rachel Cooper, available at https://www.petrashub.org/the-little-book-of-design-fiction-for-the-internet-of-things/. Copyright © 2018 ImaginationLancaster.**

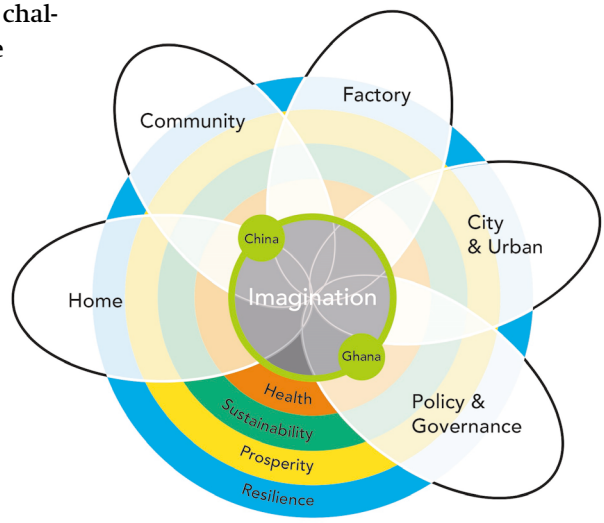
been involved at various levels with the Government Office for Science foresight Programs on Mental Health and Wellbeing and Future Cities, and the Northern Futures Open Ideas Day. Rachel Cooper advised the Academy of Medical Sciences project entitled *The Health of the Public in 2040*[64] and more recently the government review of building regulations and fire safety carried out after the Grenfell fire disaster. She is also UK representative for the ICSU Scientific Committee for Health and Wellbeing in the Changing Urban Environment.

Why is this important? Design research must not remain on the margins of the academy and design's position at the table of policy and decision making must be equal to those of science, law, and economics. We have a responsibility to champion our knowledge and ensure it is respected and valued for the contributions and value it offers.

After an incredibly successful first decade, the question of where Imagination heads next is an important and timely one. Our futures will continue to reflect the diversity and plurality of our approaches and expertise across the team, forging new research fields and collaborations whilst responding to the increasingly complex challenges of our world. These challenges and how we respond to them is what will determine our future direction.

Figure 24 **The future direction of Imagination. Copyright © 2018 ImaginationLancaster.**

As Figure 24 shows, we have developed and shaped themes and lenses that encompass many of the local, national, and global challenges that are likely to mark the next 50 years. These provide interdisciplinary platforms across which we will collaborate both within our team and outside of it with policymakers, business and organizations, communities, and other academics. By identifying them and proactively applying our attributes to them – agility, dynamism, and production of high-quality, in-depth research at an institution that fully supports us – our aim is to continue to challenge the nature of design research and apply design research to whatever is needed in line with our knowledge and expertise. In the future, we see Imagination maintaining its core staff of around 20 to ensure collaboration, communication, and consensus. We do see growth in the number of our projects, collaborators, and sites of action, which



means increasing our number of researchers and postdocs, not only to deliver more insights and impact, but to be a truly unique space where world leading design research takes place.

As a team, we will continue to focus on our purpose, whilst repurposing ourselves as we evolve as a group. However, from a leadership point of view, we will try to adhere to the management principles of an environment that supports RESPECT, RECOGNITION, LEARNING, and JOY.

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In this final section, we share with you the references alluded to in this article, but also books, articles and papers that are team have published, but also, important works by other design researchers who we feel have shaped our practice.

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