Internet of Things R&D Roadmapping Workshop
Culture, Creative and Design

July 2012
Introduction
Culture, Creativity & Design

Many ‘things’ are susceptible to being sensed, are able to communicate, can be networked, and produce new information, new activity and indeed new ‘things’ through an extensive array of technology. So we have smart/connected objects, places, people, and data. When everything is considered a ‘thing’, we have an explosion of ideas and theory about how they can be connected and used from technological, design and creative perspectives; we also have a multitude of applications from healthcare to museums, from schools to communities; but we also have questions, what is the economic value to be generated and how, what are the social, legal, ethical and behavioural implications?

This workshop is the result of collaboration between the Technology Strategy Board (TSB), Research Councils UK (RCUK) Digital Economy Programme, Arts and Humanities Research Council (AHRC), Engineering and Physical Sciences Research Council (EPSRC), Economic and Social Sciences Research Council (ESRC) and Creative Industries, ESP, ICT Knowledge Transfer Networks (KTNs). The participants who joined the cultural, creative and design theme were part of a larger group that covered economics and business, social, legal and ethical and technology themes, the aim of which was to form a workshop that focused on developing a multi-disciplinary understanding of Internet of Things (IoT). The objective of the workshop was to inform the councils, TSB, the Catapults, EU, policy makers on the key research challenges from a UK perspective in this exciting, emerging area.

The cultural, creative and design sectors are already immersed in the internet of things, for example: the museums, galleries, and archives are understanding their collections as digitised objects with attributes; the media industry is creating value from allowing audiences to access their archives and services; the gamification of the virtual and real world; whilst the creative and design sectors are hacking and tinkering with the technology to develop new services, products and systems. The aim of this themed workshop was to map and better understand the internet of things in relation to the current cultural, creative and design sector landscape both from an academic and professional perspective, and to envision areas of opportunity and possible focus in the short and long term future.
IoT Landscape Today

Participants discussed their own understanding of the IoT landscape and where they are working currently. These could be clustered into 5 main themes:

**Play:** Play included gaming and the relationship between real world and online games, the introduction of hybrid forms, using objects, for example dolls in both physical and virtual worlds, building on the relationship between the things (people, objects and space). There was much gained experience and linking up of platforms. It encompassed all forms of cultural experience such as music, theatre, and film.

**Material and digital:** Currently we have built the digital on material principles, and attaching media to objects, but there are questions arising around how do the material and physical fit together, where are the feedback loops and how do we map the relationships, what are the affordances of things/objects, how do our expectations differ.

**Data:** Data is creating opportunities for use both commercially and culturally. We are currently looking at grassroots data collection and analysis at all levels micro and macro, looking at authored content and given content.

**Manifestation:** There are immense opportunities in terms of designing visualisation, ownership and presentation forms. Here there is work around visualisation as objects, for example data sculptures, data through augmented reality the connection between data and 3D printing at small scales, local but in multiples of scale.

**Sensing bodies and places:** Here IoT is related to voice, sound, brain, senses as objects for tracking, sensing, connecting, and is being applied to areas such as dementia, health, (voice recovery) homes, and wellbeing support in general.
IoT Landscape Today

Tracking and sensing: people, objects can all be considered things, and therefore sensed and tracked. In the culture sector that means collections of any kind, indeed any cultural content and any human behaviour whether that be audiences or the individual. In terms of sensing again human responses to locations such as thermal comfort are relevant to any aspect of creative and cultural industries.

Fluidity and transparency: there is an issue related to how fluid is data between objects and also how transparent it is to the owner/provider of the data, how public and how private it is. This in turn affects our response to the opportunities and barriers of IoT, how much fear is generated or indeed lack of understanding of what is happening to data and how reliable it is. The visual properties of a digital object can be difficult to discern immediately.

Breakdown: the reliability of the components of the IOT is a major issue; the 24hour dependency and thus 24hr breakdown are major concerns today; the boundaries between night and day, global and local, home and work are fragmented; the general trustworthiness of the content as a result of a “cut and paste” culture; the ballooning of of an open source culture.

Objects and system: we are still grappling with the issue of objects and the system, of describing it and seeing objects as a point to connect to other objects; there are technical issues of connecting objects to the system and developing standards for the identity of the object; as well as providing the relationship between the object and its context and classifying that as the object or ‘thing’. We have yet to consider preconditioning the individual to understand legacy and future digital ‘ghosts’.

Tinkering and Hacking: There is a significant emergence of hacking and tinkering, of adapting use, of rapid prototyping with users and customers. Hacking new directions is significant both for the economy. But also it can create fragmentation, which can be misunderstood and disliked, and can result in problems in terms of reliability and control of the system.

User: Current theory of IoT does not allow for human behaviour either as consumers, users, and intermediaries of any kind. However the work in hacking, tinkering and rapid prototyping means we are using much more continuous beta testing and real time design especially in the cultural and creative sector.

Existing projects: Current projects in this field include a wide variety of ideas and applications including digital craft activity, wear-ables for health and wellbeing, hyper-local media, wiki towns, histories of objects, service design and disjunction, gaming (e.g. pokemon, volumique, skylander), physical avatars, robots with agency.
Future Opportunities for the IoT

The participants experience enabled them to represent where they saw the challenges and opportunities for the future as follows:

**Hacking, Tinkering, Making:** This was recognised as a current activity but with much further to go. New materials, recycling processes, 3D printing, open source ideas and technologies, are facilitating it. The opportunity for communities of practice and social/interest based communities to share objects, remix and repurpose is exploding. Hacking that includes so-called amateurs and well as professionals is a new form of innovation. It also enables us to rethink community through IoT where tinkering, mending and hacking provide alternative forms of living and working.

**Play:** Play in this sector encompasses the gaming industry, and play as purely leisure, but the boundaries are blurring. Play is used to develop and test ideas, to develop services and products and as a fundamental part of learning for both adults and children. There is clearly a huge opportunity to start to understand the space in which ‘play’ as an approach, an activity and a commercially viable strategy within the IoT, can contribute to all aspects of society and the economy. Is everything playable? Where does neuroscience fit into play, learning and behaviour change?
Future Opportunities for the IoT

Sensing bodies and place: The body as a ‘thing’ in this space embodies so many challenges and opportunities, from representing its makeup (DNA, body parts and enhanced body parts); its augmentation (technologically enhanced bodies); its history; its relationship with others; and bodies in multiples as crowds, audiences, participants (both physical and virtual). Similarly places, cities and spaces are also ‘things’ and multiples of ‘things’. The opportunity to understand the relationship between sensing of the body, behaviour, objects and places as all ‘things’, suggests the opportunity to investigate a creative method of representing the flows, connections and events, and of addressing them as a curatorial process, i.e. to connect creative approaches to the management of IoT.

User experience and people: All of the opportunities arising from IoT have huge challenges in terms of understanding user experience and human behaviour. The creative, cultural and design sector are people focused and use a multitude of practice and engagement based techniques to understand user experience. This will be critical to tap into and apply, as the explosion of opportunity with IoT occurs.

Breakdown and connections: It is recognised that IoT offers many opportunities, but this is not without challenge. The cultural, creative and design sector are content to embrace change and challenges of new technology and also to tolerate the serendipity of breakdown and novel connections, but for full social and economic value to result from IoT, the implications of breakdown and connections to the application, service or individual must be addressed head on.
Questions for Economics & Business

The opportunities with cultural, creative and design sector gave rise to a number of questions from an economic and business perspective. These included: what are the new business models emerging from hacking and tinkering? How do we track the journey of things across IoT and monitor or indeed generate value? What are the economics of playability? Should we recognise play at work? What is the nature of transaction within IoT? What is a currency in IoT, where will they emerge from, how do we recognise them? How do we understand the behavioural response and disruption? How, what are the institutional, national and trans-national implications?

Response

The participants representing Economics and Business saw the questions as interesting and challenges and did not have any specific answers, however the distinction between bottom up (users, customers, communities developing services, processes, and products through use of IoT) and top down (industry generated and delivered) was an interesting challenge. Whilst it was recognised that new types of ‘object’ or ‘thing’ will generate new business, new types of choice for the consumer, the challenge was the failure to recognise it or trade into it. Again there were as many questions about ‘play’ as an activity, what does play do, are there business models? Whilst, it was recognised play is a component of innovation, and that to operate in this space companies need creativity. Discussion around the transaction and new currencies identified further challenges and questions as yet unresolved.
Questions for Social, Legal and Ethical

Participants from culture, creativity and design had a plethora of questions for colleagues representing social, legal and ethical theory and practice. Much of the questions related to ownership of data, transparency of data, and access to it. If our bodies, our information, behaviour, possessions, products, services are all 'things' where are the boundaries, who owns them in the flow, sharing and use process, how can we track it, how is it commodified and categorised (copyright, licensing). Are the 'things' entities in their own right, are objects (people, products, places) more honest than things.

Response

In discussion with colleagues, it was clear that many of the issues raised by developments in culture, creative and design sector were still emergent for the social legal and ethical community and therefore a critical challenge to address.
Questions for Technology

Questions to technology experts of course related to the technology available to facilitate IoT ideas, trends and possible developments. For example how can we make objects with networked AI that can learn from or enquire from the conditions/environment and requirements we give them? How do we create modular systems? How can we create flexibility? How can people be empowered to undermine the designed limitations of things, what tools can be created to do this? All such questions relate to the potential approach taken in the technological system related to IoT, how much can be emergent, flexible and user driven, how much will be technologically driven and corporately controlled.

There were other issues related to the robustness, and life of the technology and the data arising from the IoT, such as how long lived is the technology, should we allow it to decay and die, what happens then? Does it matter if we lose data?

Response

Technology experts were able to deliver current knowledge on IoT systems and solutions, and in response to the specific questions, again saw them as opening up new insights and challenges.
Research Challenges
Internet of Things R&D Roadmapping Workshop: Culture, Creative and Design

Opportunities / Themes

PLAY

High-level Challenge

Extension / developing value from play

Specific Research Challenges(s)

- Play + immersive values (Play by Design)
- PLAY as simulation / innovation
- Cultivate strategic opportunities
- Explore immersive languages
- How do we keep these, tell us with people (and use technology, new tools)
- Value future
- R&D foundations

Timeline

- 3 months
- 1 year
- 2 years
- 3 years
- 5 years

Skills

- Interdisciplinary collaboration
- Interpersonal relationships
- Analytical thinking
- Critical thinking
- Bruno Latour
- Design thinking
- Play by Design
- Innovation
- Technology
- Entrepreneurship
- Leadership
- Science
- Arts

Specific Research Challenges(s)

- Immersive technology
- Fusion of play - impact on innovation
- Physical, digital, sensor, fan
- Understanding objects within multiple contexts
- What is the game changer?

Specific Research Challenges(s)

- Permission to play - involvement in design
- R&D for the things people enjoy

Timeline

- 3 months
- 12 months
- 2 years
- 3 years
- 5 years

Skills

- Design
- Entrepreneurship
- Collaboration
- Innovation
- Leadership
Outcomes

High-level Research Challenges

1. Meaningful frameworks that enable play, making and adaption in an agile co-development and co-evaluation research process.

The emergence of hacking, tinkering and play in the cultural and creative community is obviously a source of innovation and a potential for economic growth and social benefit. It emerged as a major opportunity area in the cultural, creative and design theme. It needs to involve designers, artists, hackers, makers, developers, and users, and we need to explore different operating models, feedback and share best practice, and build communities of expertise. It should not be overburdened and bureaucratic but participants recognized it can be disruptive and risky and so the need to co-create a fiscal environment (i.e. one in which investment is available), an operating and technological and legal environment in which knowledge and technology can be shared in a commonly agreed manner.

2. Making data tangible - all types of data.

We are aware of the explosion of data. The cultural, creative and design sector, see the challenge and opportunity to undertake far more work on the translation, visualization, and access to data (cultural archives, organizational and personal archives, open source data, analytics) in order to make data manifest, reduce its obfuscation and improve trust.

3. Understanding and knowing bodies; interconnections, disconnections and flow (representation, agency & power).

IoT as a system and the human body as a ‘thing’ within it are not readily understood. How we sense the body through prosthetics or emerging technologies, design systems for and around the body (athletes and patients being possible extremes), represent the body and its agency and power embodied within the IoT system, whether that be in relation to social and cultural life (communities, games, cultural artifact etc) or general work and life, and the disconnections we create between our bodies and their environments, is a major area for research.
There is a huge area of unknown in terms of how we will work within the IoT system, what will it do to work, what will it mean to work, and indeed how we balance home life and work life. The design and creative community will develop new products and services built around the opportunities offered by the IoT, what and how to facilitate this, and ensure it contributes to improved quality of working and home life.

5. Digital life and death.
By creating digital artifacts, archives and data, we need to understand the life of this digital material, how it is used, who has access to what aspects, the “things” it is attached to, how it transitions between people and communities, how we manage reuse, decline and decay. How we signify and ensure death of data and who has the moral, ethical, legal authority to do this?

6. Individual, Social and Organisational response and drivers to and for the IoT.
The cultural, creative and design sector is engaging significantly with IoT and yet there is still very little coherent evidence in relation to what constitutes reliable driver for the development of IoT and what models or algorithms in response to it are emerging.

7. Environment & sustainability; bringing the IoT thought into the sustainability space.
Many of the constituent parts of IoT (sensors, data management, building and space manipulation) are being used in the endeavor to preserve the environment, reduce carbon and engender more sustainable forms of living. However, there are many more opportunities to bring a broader systemic approach to the challenges through IoT approaches that empower end users and negotiate hierarchies of ownership and access.

8. Narrative, storytelling & user experience.
Critically an essential contribution that can be made to the development and implementation of IoT, is communication, discourse and user engagement. The cultural, creative and design sectors are skilled in generating narrative, scenarios and audience engagement through theatre, film, literature, journalism etc as well as user centred design and development of the IoT experience.
Conclusions

The cultural, creative and design theme mapped the current landscape relevant to Internet of Things and identified 8 research and R&D challenges that are important areas of focus going forward.

It was felt that within each of the challenges there were aspects that were short-term and long-term in our theme, so for example, though a technology may not be ready to exploit in the short-term, there is an opportunity to use cultural, design and technological interventions to explore the implications and impact in the short-term in order to feedback into shaping its long-term development.

There is a sense that that the consultation exercise has been fruitful and helpful to all those involved but policy and funding needs to show the impact of this exercise in the near future, partly as the landscape is changing and also to demonstrate its usefulness.
Participants

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Process

The workshop participants had four tasks;
1. to describe the current IoT landscape from their perspective;
2. to outline future opportunities;
3. to identify questions these opportunities posed for economics and business, social, legal and ethical, and technological perspectives and;
4. to express the research and R&D challenges for IoT.

Contributions

This workshop included special contributions from speakers to spark ideas and stimulate conversations:
- Chris Speed, Edinburgh College of Art
- Mike Philips, Plymouth University

Facilitation by Rachel Cooper, Rachel Jones, Chris Speed and Mike Philips with assistance from Jonnet Middleton, Natasha Carolan and Roger Whitham.

We would like to thank all the participants for their engagement.