

Bio

Rob Phillips is a product designer with a 15-year industry background and currently a senior tutor in *Design Products* at the *Royal College of Art*. He creates user-orientated solutions supported by design workshops using design approaches to commercial and academic situations. His PhD entitled, *The Bee Lab kit: activities engaging motivated lay users in the use of open technologies for citizen science activities*, investigated a relationship between open design and citizen science.

The Bee Lab project

Applying Citizen Science and Open Design to beekeeping, enabling participants' to construct monitoring devices gathering reciprocal data, motivating participants and third parties.

In 2006, professional beekeeper Dave Hackenberg noticed that 368 hives out of 400 were almost empty. This loss of 85% of his colonies, comprising 3000 hives, equated to \$450,000 of income. These individual findings were shared with local university entomologists, who started to note similar findings up and down the United States. This phenomenon was later called Colony Collapse Disorder (CCD). In *A World Without Bees*, Benjamin *et al* discuss the CCD crisis that could face an international audience. Without the survival of the honey bee, the human diet would become bland and the proliferation of wild fauna would be reduced, affecting species reliant on wild produce and, in turn, the entire eco-system and bio-diversity of the planet. The farming minister Lord Rooker told parliament in November 2007, 'we do not deny that bee health is at risk. Frankly, if nothing is done about it, the honeybee population could be wiped out in 10 years'. Since these developments, the British Government and Defra have established research programmes reviewing the concept of 'Bee health'. These initiatives stem from a top-down model governed by international researchers, scientists and government bodies.

In the mountains of Sichuan in China, workers hand pollinate pear trees with chicken feathers attached to bamboo canes and have been doing so for 20 years, as their honey bee populations have become extinct due to over pollution and lack of response. This practice of hand pollination is expensive and does not cater for wild varieties of fauna, which other species might rely on. In *Valuing Insect Pollination Services with Cost of Replacement*, Allsopp *et al* examine pollen dusting, pollen sprayed from planes, which requires two aerial applications per hectare. Pollen spraying is also costly and mainly used for agricultural purposes, not including non-agricultural areas. Insect pollination is an important ecosystem to agriculture, improving production in 75% of global crops demonstrating the insect's importance.

The recording of seasonal events has been a pastime amongst natural historians in Britain with records going back to the 1730s. Citizen Science is the participation of non-scientists in data collection for scientific investigation. Professional monitoring is often costly, often not sustained over time and can be difficult logistically, technically and analytically but encounters fewer inaccuracies. Citizen Science provides an indispensable means of combining environmental research with education and wildlife recording. A pertinent Citizen Science example is children, living in rural areas, using their bus journey to school to catalogue deer, elk and domestic livestock sightings. Galloway *et als'* project uses participants 'unconsumed time' (on a bus) to catalogue species proliferation.

The RSPB's (Royal Society for the Protection of Birds) 'Big Garden Bird Watch' demonstrates that public audiences are willing to participate in CS activities and actively investigate nature, with over 600,000 documented participants in 2011. In *The Natural Choice: Securing the Value of Nature*, a Defra White Paper, authors highlight that Government and society need to account for the value of nature, particularly the services and resources it provides. Design is evolving beyond the manufacturing of artefacts and services, including the distributed manufacture of those artefacts/services, catering to local or 'social needs'. Social design and design interventions are giving people the capacity to respond to local and situational needs. The uptake of social design has increased due to the Internet's freedom of information, complimented by accessible manufacturing. Whilst the production of objects can

now be accessed by school children, designers, manufacturers and retailers need to consider expected/unexpected 'impacts' isolated design interventions might have.

Throughout history, technology has been an agent of change, with examples including the printing press, the sewing machine, mobile communications, the internet, 3D printing and open hardware. These tools and resources have shifted the economic model of design from a top-down model, to aid tool owners and lay users to actively contribute design inputs and outputs. The barriers to entry for lay users creating and adapting technology have been lowered by the democratisation of machineries, the Internet and fabrication laboratories located around the country. Accessible technologies are enabling knowledgeable but untrained users to construct intelligent artefacts that can monitor, record and subsequently produce data. The data accrued by these artefacts can be instrumental in scientific research, exploring contextual situations and answering non-professional communities' research questions. This volunteer monitoring, or 'Citizen Science', extends the reach of organisation(s) and has traditionally been initiated from a top-down approach. The intended audience for this PhD work is: Citizen Science practitioners, designers who want to engage lay user audiences, museums, conservation organisations, and charities. These audiences can benefit from involving lay users and relevant technologies in gathering environmental data, meeting individual and organisational needs.

In the *State of Nature 2013*, report authors present that people should 'act to save nature both for its intrinsic value and for the benefits it brings to us that are essential to our well-being and prosperity'. Authors highlight that 'what we do know about the state of the UK's nature is often based upon the efforts of dedicated volunteer enthusiasts contributing their time and expertise to species recording', so they should be mutually motivated in investigating personal needs to participate (Burns, Eaton et al. 2013). The combination of accessible design content, social design and response to local issues presents wider issues that crave attention. An example of 'wider impact' was the United Kingdoms, 2001 foot and mouth epidemic. Foot and mouth is spread by contaminants transferred to footwear and carried over areas. In 2001, the South Downs (1600 km²), located in East Sussex, was closed stop the disease's spread. The public's misunderstanding of their foot traffic wider impact, exacerbated its spread. The disease claimed many farms and 'resulted in losses of £3.1 billion to agriculture'. Legislation determines how people engage with rare species and the countryside, but currently there are no legal considerations for accessible design, citizen science activities. Currently it is easier to avoid these conflicts and find communities that would benefit from gathering data on their local environment.

The *Bee Lab* Citizen Science Project is a response to recent trends complicating the practice of beekeeping observed over the last 15 years as a result of pesticides, GM crops, changing environment, weather diversity and disease management. The projects approach was to learn lessons from helping people make their own technologies and see pitfalls, benefits and opportunities through real world applications with real community groups. The approach appropriates digital technologies and encourages the use of existing skills, in order to unlock data silos, develop community-wide knowledge exchange, and facilitate greater public investigation of wildlife at a distance (specifically in situations where smartphone use is inappropriate). The project's research objective is to understand the requirements for lay users creating Citizen Science monitoring tools from Open Design plans; to comprehend the pitfalls and opportunities and subsequently use aggregated individual bee hive data to contribute toward community bee health insights.

The project builds on the notion of *reciprocal motivation* (project stakeholders motivated by giving and receiving), and data gathering by beekeepers in the UK, to form stronger community bonds with each other and design and share their own solutions to personal, community, and global issues. *Bee Lab* achieves this by including beekeepers in the design, assembly and deployment of *openly designed* monitoring devices. This investigation provides insights regarding the design of kits for Citizen Science in general, removal of application barriers, translation of user concepts into research in the wild or Internet of Things devices, and including users in Open Design processes.

Design and mass customisation are already mainstream. Accessible technologies will become the founding platform of future educational platforms. This accessible space aligned with other social needs requires contemplation. The project was not meant to produce a 'judgemental manifesto', but it is meant to inspire a different way that we (collectively) can design and create harmoniously within our surrounding society or community.

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