ENTREPRENEURS, SQUATTERS AND LOW-TECH ARTISANS: DIYBIO AND HACKERSPACE MODELS OF CITIZEN SCIENCE BETWEEN EU, ASIA AND USA

The global spread of alternative R&D places outside the universities and corporate labs offers an integrated model for art and science cooperation and public participation in science. These places (Hackerspaces) and projects (DIYbio) offer a direct involvement of citizens in the R&D process in term of translational and participatory research. What are the opportunities and challenges of these novel institutions across the globe?

AUTHOR(S)

- Denisa Kera

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While media, government, non- and inter-government organisations were speculating on the size of the Fukushima Daiichi nuclear disaster and discussing issues of nuclear safety, standards and policy measures, individuals and small groups of citizens involved in grassroots science activities around the world were measuring, monitoring and crowdsourcing real-time radiation data over DIY tools and sharing data over the web. [1] This agile and resilient response to a situation of insecurity and lack of data was initiated by people around the Tokyo Hackerspace [2] and their friends from Portland and Los Angeles with connection to the global Hackerspace community. [3] It resulted in creation of a platform, Safecast.org, over which data on radiation are gathered from almost 300 nodes [4] and which also serves as platform for supporting creation and distribution of DIY Geiger counters.

Hackerspace community is just one of the examples of Do-It-Yourself (DIY) and Do-It-With-Others (DIWO) initiatives that are emerging in recent years everywhere around the world challenging our views of citizenship vis-à-vis emergent technologies but also disasters. Fukushima disaster in April 2011 showed how this informal network of Hackerspaces around the world was able to react and coordinate efforts in developing low-tech tools which Akiba, the uber-hacker from Tokyo Hackerspace, poignantly named "Humanitarian Open Source Hardware." [5] These DIY tools were distributed over another recent prototype of a service, a community market for open source hardware, InMojo. [6]

This immediate, decentralized and global response to a disaster goes way beyond the common but also imagined forms of solidarity and innovation. Crowdsourcing not only ideas but also materials for building DIY Geiger counters and even prototyping and designing new tools such as the Kimono Solar Lantern Kit, a hackable solar powered lantern for $12 named after a bar next to Tokyo Hackerspace, or iPhone Radiation Dock (iGeigie), portable Geiger counter, present a new type of global and participatory design which combines solidarity and innovation. [7]

These prototypes directly connect technological standards (open source) with deliberations on social action in a global and day-to-day context via various DIY and experimental management techniques. They bring together politics, technology and nature in a direct and transparent way that offer resilient and open structure for participation and decision making. Control and decision making (in terms of monitoring, reflecting and self-organising) are instantly connected to scientific facts, laws and technological standards via design prototypes, which are political, social and technical at the same time. Design in the case of radiation data becomes a form of participatory but also global and collective action redefining the relations between lay people, science experts and political representatives. Furthermore, the speed of the response, including the actual design

of the prototype and the launch of the participatory monitoring of radiation platform over Safecast, took impressive 72 hours of work by enthusiasts from several Hackerspaces around the world. [8]

The Hackerspace infrastructure that made possible the citizen science response to Fukushima was already in place long before the disaster and it is used not only in the case of software and hardware innovation but also in the case of so called DIYbio research specializing on various aspects of biotechnology and even medicine. Similar movements and places define an alternative R&D structure that uses design as a convergence of social and technological innovation. These small scales, experimental, alternative R&D structures represent a convergence of several radical ideas around development of open source software and hardware (Hackerspaces), [9] cheap and open source, digital fabrication (FabLabs), [10] citizen science labs crowdsourcing biotech research (DIYbio), [11] innovative coworking and management structures (HUB). [12] These innovative, coworking experiments paradoxically combine the squat and publically funded culture of the EU art centres with the market driven entrepreneurship rhetoric of the US start up scene to envision research and innovation outside the traditional professional settings of universities and corporate labs. The insistence on low-tech solutions and open source technologies democratizes the whole R&D process to a degree that it makes it possible for developing countries to join as we can see in the case of Fablab in Africa [13] and Afghanistan [14] or the now famous "House of Natural fiber - Yogyakarta new media art laboratory" (HONF)" from Indonesia. [15] HONF founded in 1999 is not only one of the oldest alternative R&D place outside of EU or US, but also the most original, because of its unique combination of influences and its relation to the local community and culture. It is an artists' run organization that is occasionally funded by EU (for example their recent Fablab) thanks to their global art network connected to a festival of new media art which attracts the EU crowds with access to money. However, it is also a coworking space and privately funded organization that is supported by its members in a manner similar to US based citizen labs and Hackerspaces with occasional contact to the local universities and companies.

While in 2008 and 2009 the whole alternative R&D movement gained a momentum in terms of popularity thanks to various citizen science research projects related to Hackerspaces but also DIYbio labs and the Maker's community, the 2010 marks the start of the global movement which proved its usefulness and resilience in the recent Fukushima disaster. The global movement is defined by various events around the world that identify with the idea of citizen science projects, low-cost and low-tech protocols, lab equipment based on open hardware and shareable and reproducible kits. The common strategy of connecting the DIYbio labs to the local Hackerspace communities is widespread even if it is not the only model. The more socially and critically involved hacking similar to EU art and DIYbio centres is typical for most of Asia DIYbio and Hackerspace scene while Singapore seems to follow more the US orientation to entrepreneurship and personal enhancement. Experimental forms of research, investment and even artistic creativity show clearly how the "low-tech but high-impact" logic of the DIYbio and Hackerspace movement operates in various contexts and how it can connect science, culture and society in ways that traditional policy and public participation in science research could not even imagine.

The artistic and scientific solutions and protocols are affecting but also involving large groups of citizens and stakeholders in the process of the research, creation and innovation. Whether in US, EU or Asia, the Hackerspace revolution involves open source laser cutters and other open hardware tools that can create cheap lab equipment, enable synthetic biology recipes and other protocols to spread like cooking recipes, self-organized clinical trials and other community related projects that are challenging not only in technological but also in social sense. The strategies and interests of these groups are slowly converging into one informal network between Asia, US and EU enabling very different flows of knowledge and expertise. It also paradoxically embraces, develops and combines two extreme strategies of R&D, on one side the market driven entrepreneurship model following the US, on the other side, the anarchistic, underground model of the EU based squats.

Various forms of bottom-up organizations that appear in recent years around emergent technologies, DIY subculture and novel forms of investment in innovation and entrepreneurship provide interesting case studies for studying the relation between politics and design, new technologies and social movements, emergent "non-humans" in Latourian sense [16] and transforming society. Whether we are speaking of alternative "R&D labs" that are part of some existing cultural and art centres such as Ars Electronica in Linz,

ZKM in Karlsruhe, FACT in Liverpool, Laboral in Gijón, or alternative incubators like Hackerspaces, HUBs, MAKE fairs etc. we can witness the crucial role of radical design and politics play in connecting humans and non-humans and experimenting with new networks. The emergent networks are not simply explored by these institutions but actively performed and created by novel forms of research, investment and even artistic creativity and social experiments around open source laser cutters and other hardware, synthetic biology recipes, sharing and discussing DNA data, self-organized clinical trials, various types of performance software, robotics and any simply any emergent technology. [17] Communities of people monitoring, sharing and making sense of various "objective" and "scientific" data in their everyday life are actively exploring and performing the future symbiotic relations between various types of agencies across scales. The true cosmopolites of today are people actively involved in platforms such as Patchube, [18] Carbongoggles, [19] DIYbio list [20] etc. exploring the emergent, often surprising connections, networks, and mashups between different actors and scales.

From nano- and bioart exhibitions to annual new media festivals, various museums of the future and alternative incubators we are witnessing public involvement with emergent sciences and technological inventions that go across business, art and research. The various functions of such spaces from the more obvious like popularization and presentation to the more professional like investment in innovation to the more creative and experimental like envisioning our common future the goal is similar to the early ideas and vision of science, technology and art interactions. It is to foster and accelerate the ability to connect various actors in new networks and ecologies across scales. [21]

The strange paradox in this new type of DIY, citizen science projects and institutions is how the increasing involvement of the public goes in parallel with the as intensive emergence of new actors across scales. The non-humans seem to talk a lot lately via various data that we are able to generate, gather and visualize in the citizen science projects that involve low cost monitoring, sharing and interpretation of various data but also in various hacker and maker projects. The public interest in data defines these new communities intimately connected to their environment on various scales from molecules, DNA and cells to institutions and cities (BioWeatherMap, [22] EpiCollect, [23] and CamMobSens [24]). We are even starting to witness large, bottom-down projects envisioning the future cities as microstates and software platforms performing such new ecologies and systems (Digital Cities, City 2.0, Intelligent Urbanisation, Cities-as-a-service, Smart+Connected Communities, Cisco's New Songdo, IBM "Smarter planet", HP "Central Nervous System for Earth"). [25] The cosmopolitical future is in connecting actors across scales via data and creation of new dependencies, metabolisms, systems, networks which do not make a difference between the organic and non-organic actors, between the social, political and biological, but create new relations across scales.

These interactions across various scales and not only actors (atoms, molecules, cells, humans, institutions, cities, planets) seem crucial in terms of connecting design and politics. These networks between heterogeneous actors and across various scales hold the key to any future hybrid communities which we are starting to witness with the alternative R&D. While most projects dealing with future communities and issues of sustainability and/or biodiversity still concentrate on the scale of animals, plants and large ecosystems, the interest is slowly shifting to more complex interactions between humans, microorganism and molecules on the micro-level that often defines new communities and micro-ecologies through sensor data. The data we gather about our bodies (for example DNA), society (like mobile use, consumption etc.) and nature (CO_2, radiation, whether, bacteria) are integrated over various platforms and interfaces to help us understand the unique equilibria but also develop and create new habitats. The various functions these experiments from the more obvious like popularization and presentation to the more professional like investment in innovation and more creative and experimental connect politics with design, social innovation with prototypes. These DIY and alternative places perform, foster and accelerate the ability of science and technology to serve different purposes and connect various actors in new networks and ecologies. The very democratic form of these institutions that support bottom-up and citizen science projects defines them as true cosmopolitical laboratories and defines cosmopolitics not only as experiments with novel networks between actors but more importantly between various scales. The main issue of cosmopolitics for this reason is not a problem of the subject-object, animate-inanimate relations but issues of interaction between scales, relation between parts and newly defined wholes.

Furthermore, all these citizen science and bottom-up projects that gather various data, actors and connect scales strangely revive the pre-modern ideas on human and non-hu-

man interaction like bestiaries and cabinet of curiosities and the original project of the "Academy of sciences" envisioned by G. W. Leibniz that also speak of such radical hybridity. [26] These novel forms of community organised and financed science and technology labs revive the original idea on science, technology and public interactions envisioned by G. W. Leibniz in his famous "Odd Thought Concerning a New Sort of Exhibition (or rather, an Academy of Sciences ; September, 1675)." In this original vision of the academy of sciences Leibniz ceases to discuss the advancement of sciences and technology in terms of metaphysical and philosophical issues of truth, limits of human mind or the nature of reality but defines science and technology by their ability to generate new ecologies of interest and influence, new institutions, networks and relations between different actors. Science, technology, business, art, entertainment, tourism are all part of an effort to raise human curiosity and wonder and transform the society. Leibniz's prophetic vision of cosmopolitics modelled after his ontology of monads and interactions between different scales is a reality today in the case of hybrid organizations such as Ars Electronica in Linz, ZKM in Karlsruhe, FACT in Liverpool, Laboral in Gijón, numerous small centres around the world and alternative incubators (Hackerspace, DIYbio, HUBs) that connect art, design, technology and sciences in often playful and unexpected ways. [27]

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