Hacking sustainability: Broadening participation through Green Hackathons

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Abstract. Green Hackathon is an international series of coding events with sustainability purpose. Developers, researchers, environmental practitioners, and anyone else who is interested, work for a limited amount of time to create innovative software solutions for sustainability. These events have explicitly aimed to invite a broad spectrum of expertise *besides* technical expertise. This article presents the experiences and tensions of including these end users at a mostly technically oriented event, and discusses how end-user development could be used to encourage more reflective practices and as well as broadening the participation and the interdisciplinary collaboration in these events – with higher-quality as a prospective outcome.

Introduction

Hackathons are events where developers, programmers, designers and computer amateurs in general meet and work intensively to create software projects. The word hackathon is a portmanteau of hack and marathon. The reference to "hack" is not to hacking as in computer crime [1], but to the original meaning of a hacker as someone who "programs enthusiastically", who believes that computing and information sharing is a positive good and who believes it is an ethical duty to facilitate access to computers and computing resources [2,3,4]. The "marathon" part points to the "endurance" side of the events as many hackathons run for extended periods without pauses. Hackathons come in many different sizes and shapes, but the basic format is that of a concentrated programming effort (not seldom 24 or 48 hours) and with teams (perhaps formed impromptu) working with all stages from 1) inspiration and ideas to 2) concepts and designs and finally to 3) a demo with (preferably) running code. Hackathons can have different focuses, for example generating business ideas[1], creating music software[2], playing with NASA's space data[3] or hacking for social change[4]. Organizing a hackathon naturally demands that the organizers take practical considerations into account such as sponsorship, food (plenty and free), appropriate

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1 24 hours business camp http://www.24hbc.se/
2 Music hack day http://musichackday.org
3 NASA International Space Apps Challenge, http://spaceappschallenge.org/
4 Random Hacks of Kindness, http://rhok.org

facilities (a good Internet connection is crucial), local collaborators and stakeholders, and of course the means and the channels to attract (local, talented) participants[5].

Green Hackathon is a series of hackathons events with an environmental profile, and the task is more specifically to develop prototypes and demos with a sustainability purpose. The events focus broadly on issues pertaining to sustainability (for instance climate change, energy, food, transportation) and at creating functional prototypes and proofs of concept. While there have been examples of hardware hacks being produced, the most common form of results are web applications and software, for example to help decrease carbon footprints or to visualize sustainability data and sustainability information to make it more understandable. Green Hackathons[6] were initiated by Hannes Ebner and Jorge Zapico in Stockholm in 2011 and has since become a series of community events organized locally by different partners in different countries. Key factors in managing to scale up the concept beyond the first event has been to open participation and allowing people to organize their own Green Hackathon events. Subsequent hackathons in London, Helsinki, Athens and Zürich have primarily been organized by local groups, but under the Green Hackathon umbrella, creating an international community of practice. Founders (and paper co-authors) Hannes and Jorge have collaborated with and to a greater or lesser degree participated in all the events that have been organized this far.

One of the main driving forces of Green Hackathon is to use these events to *broaden participation and increase interdisciplinary cooperation*. Participation is open to anyone and the events have explicitly invited a wider audience in order to foster interdisciplinarity and innovation. While most participants have technical backgounds, like programmers or web developers, also researchers, environmental experts, designers, journalists, farmers, decision-makers and investors have participated in these events. The Green Hackathon events have thus explicitly attempted to bridge differences between a variety of communities, i.e. developing inclusive or "bridging" social capital [5], and fostering interdisciplinary collaboration between them to develop innovative software. This is in line with the research topic of end user development, that can be defined as "a set of methods, techniques, and tools that allow users of software systems, who are acting as non-professional software developers, at some point to create, modify, or extend a software artifact" [6]. From an end user development (EUD) perspective the Green Hackathon events can be studied from two points of views:

1. By (especially in comparison to other hack events) broadening participation by involving non-computer-professionals in the creation and shaping of innovative ICT technologies.
2. By bringing people with different expertise to work with problems and with data usually reserved for sustainability practitioners and researchers.

This paper presents our Green Hackathon experiences with a focus on the broadening of participation and collaboration in working with ICT and sustainability. We will

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5 See the Hack Day Manifesto http://hackdaymanifesto.com/
6 For more information see http://greenhackathon.com

discuss how participation could be further broadened and why the hackathon format is a relevant example of the connection between the hacker-maker culture and end-user development.

Results

The first Green Hackathon was organized in Stockholm in October 2011 and Green Hackathon has thereafter become an international series of events organized by different partners under the same name; London in January 2012, Helsinki in September 2012, Athens in December 2012 and Zürich in February 2013. These events have experimented with a variety of different formats. The Stockholm and London events were two-day, 24-hour events where participants were allowed to stay on the premises throughout the event (which many participants did). The Athens Green Hackathon was a three-day event, with the first day dedicated to brainstorming ideas, the second day to coding and the third day to presentations. The Zürich Green Hackathon event was a pre-conference activity at the ICT for Sustainability (ICT4S[7]) conference and was a shorter than 12 hours and stretching from early morning to late evening. The Helsinki Green Hackathon event was part of the Open Knowledge Festival[8] and was not a competition, but rather more of a drop-in event during two days with presentations, collaborative coding and break-out sessions where groups worked together on a specific problem. The number of active participants have varied between 20 and 60 with additional persons dropping by for a limited amount of time or listening to the final presentations.

Fig. 1. Pictures from the Green Hackathon in Stockholm (left) and Zürich (right)

Green Hackathons work practices have been flexible with most participants working in groups, either formed before the event or formed ad-hoc at the event. Some participants have worked by themselves (on a project of their own) or even gone around to help out in different groups. The same patterns could be seen also among non-technical participants, but with some actively looking for coders to help implement an idea of theirs. Switching groups or helping different groups out by
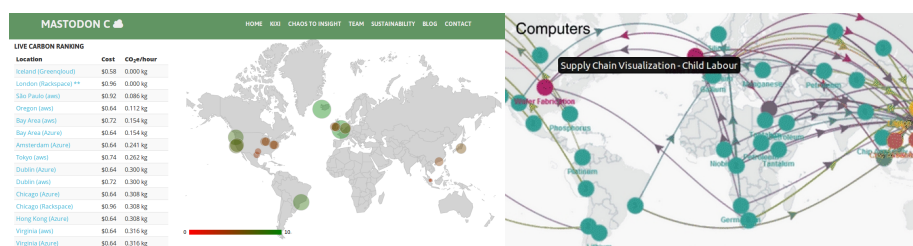
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7 http://www.ict4s.org/
8 http://okfestival.org/

providing ad-hoc help based on individual expertise has been more common among non-developers than among developers.

Almost all events had an element of competition [7]. Most Green Hackathons have ended with project presentations and a decision as to which were the "winning hacks". That decision has been taken either by a jury (Stockholm, London) or by popular vote (Zürich). There have not been any formal evaluation criteria, but "winning hacks" have excelled through a combination of 1) quality of the core idea from a sustainability point of view and 2) technical implementation and with a "working applications" (prototypes, running code) being much preferred to presenting "only" mockups or cool ideas. Most events have had just a general category, but the London Green Hackathon had different prizes for different categories like "the built environment" and "transparency" (these were sponsored by specific companies or organizations).

We present a few hacks[9] below to better show examples of ideas that have been implemented, as well as different working strategies and participant roles (e.g. division of labor):

- *Mastodon C*[10] is a web application that allows users to select the most efficient and sustainable location for cloud computing jobs. It does live calculations based on the current energy mix at the location and the current temperature[11]. The hack was created by a programmer, a mathematician, and an anthropology PhD student researching sustainability. Mastodon C got funded after the London Green Hackathon event and the application is currently being further developed in a start-up company.

- *Social impact of supply chains*[12] build on the existing tool Sourcemap, an application for visualizing supply chains. "Social impact of supply chains" mashes up supply chain information with public UN data to display the likelihood of child labor being used in each country being involved in the manufacturing of a specific product. This prototype was created by two employees from Sourcemap with input from a researcher with expertise on social life cycle assessment.

Fig. 2. Screenshots of Mastodon C (left) and Social impact of supply chains (right)

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9   A list can be found at http://www.greenhackathon.com/category/hacks/

10 See http://london.greenhackathon.com/hacks/mastodon/ and https://www.mastodonc.com/

11 The current temperature is important because cooling consumers large amounts of energy in data center operations.

12 See http://greenhackathon.com/blog/2011/visualizing-the-social-impact-of-supply-chains/

- *Swiss Nuclear Energy*[13] visualizes the use of nuclear power in a Swiss context by showing how much it contributes to the energy mix in different Swiss communes. This hack was created by a journalist who showed up with an Idea, and a developer who scraped the data from stromkennzeichning.ch and created the visualization.
- *Carbon Minecraft*[14] is a mod for Minecraft that adds information about the carbon emission footprint of different actions in this popular computer game. When players for example burn wood in the game, the mod calls the AMEEconnect[15] API to calculate the CO_2 footprint of that action. The result is added to an in-game tracker and the cumulative effect of (in-game) CO_2-related actions affects how the atmosphere is visualized. This hack was created by a single person with dual competence as a developer as well as being an expert on ICT for Sustainability.

Fig. 3. Screenshots of Swiss nuclear power (left) and Minecraft carbon mod (right)

Analysis

The Green Hackathons have been successful in generating prototypes and applications. A key characteristic that makes the hackathon format productive is the combination of providing a long but limited stretch of uninterrupted time to work. The opportunity to work on one particular task for 12 or 24 hours - uninterrupted by meetings or other distractions - is unusual in the current work culture. The hackathon format provides an opportunity of working on a new, exciting project or with an idea that has been around for some time, waiting for an opportunity to be developed. The limited amount of time is also a key factor. Parkinson's law wittingly states that "Work expands so as to fill the time available for its completion" [8] where the hackathon "forces" participants to concentrate hard, to produce and to deliver.

This focus on "getting things done" is an important part of the hacker ethic and the computer culture as well as of the maker and the DIY communities with their focus on hands-on approaches, of "showing results" instead of just "talking about ideas" [9].

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13 http://www.greenhackathon.com/blog/2013/swiss-nuclear-energy-visualization/
14 http://www.greenhackathon.com/blog/2011/hacking-carbon-emissions-into-minecraft
15 https://www.amee.com/pages/api

Practical problem solving and the process of moving an idea forward to a prototype or a functional application is what "makes hackers tick" [10] and hackathons embody these values by focusing on creating prototypes and working applications (running code). Having good ideas are important, but of decreased value if you can't show any running code at the end of the event. At these events, functional prototypes and running code always beat nice-looking but non-interactive mockups! While getting things to work and showing results is a core hacker culture value, other Green Hackathon aspects are more playful [11]. The "competition" component is not taken too seriously and the value of the mostly symbolic prizes are puny compared to the economic value of participants' investment of time. The competition is in itself clearly not the main driver for the participants - as apart from other motivations such as doing things together with others, contributing to the community, partaking in the creative joy of making something new together, and of showing off.

The Green Hackathon events have also been important physical social events, by broadening participation and helping to build a community of interest that bridges different disciplines and that provides face-to-face connections between otherwise distributed or loosely connected individuals. The importance of the social-physical-corporeal aspect of these types of events has been pointed out time and again by Coleman [12], Moilanen [13] and Pargman [14]. Coleman discusses at the functions of "hacker con[vention]s" in terms of facilitating contacts between new persons, meeting up with (previously) exclusively-online contacts, reinforcing existing groups and (further) build up community bonds. The physical and social dimension is also important in other representations of hacker and maker communities such as makerspaces and hackerspaces. As a social event, Green Hackathon also plays an important role in broadening participation by bringing together diverse groups such as developers, designers, usability and interaction designers, facilitators, sustainability experts of various kinds, data owners, problem owners, sponsors, jury members and spectators. Some participants take on more than one role such as organizers who double up as developers, or problem owners who double up as sponsors or spectators.

The most concrete results of the Green Hackathon events are of course the hacks themselves. The hacks are quite heterogeneous within the relatively wide constraints of creating some kind of technological prototype that has some kind of sustainability purpose. The commercial potential of ideas has not been a focus at the Green Hackathon events and many of the results are in fact playful, sometimes boisterous internal jokes or smart tweaks that follow from a traditional joyful hacker culture work approach [15,16,2,12]. There has, on the other hand, been hacks created that have become part of existing commercial efforts, and others hacks have gone on to become startup companies such as Mastodon C (see above).

Discussion and Conclusions

Our (albeit partial) opinion is that the Green Hackathons have been successful events, creating interesting results, building community and encouraging collaboration

between different communities of practice. Green Hackathons, while focusing on developing technology, have explicitly been open to participants both with and without technological expertise. This text has presented our experiences, with examples resulting from collaborations between different competences. We have also briefly discussed the dynamics of "adding" non-developers to a developer-centric event. Based on our experiences of having organized five Green Hackathon events, we suggest a number of different strategies that could be tested in order to further broaden the quality of the participation of non-developers at these events:

- **Better matchmaking of technical and non-technical expertise**: Matching expertise and competencies has been either ad-hoc or loosely organized. A better matchmaking process with the explicit aim of fostering better collaboration between technical (developers, designers) and non-technical participants (people who have a great idea, who "own" a problem or a set of data) could be organized at the beginning of the event. Our experiences imply that a better mix of various competencies leads to better ideas, better teams and better end results.
- **Formalized wanderers:** We have observed that some people chose not to join a specific team, but rather chose to contribute their expertise to several different project during an event. These "wanderers" have been found both among developers helping out with technical expertise and among non-developers, for example environmental experts, answering questions or in other ways helping out based on their domain expertise. This role could be formalized, providing different teams with on-demand (technical or non-technical) expert "consultants".
- **Lowering the perceived technical difficulty:** The events have provided information about existing data, APIs and tools that could be relevant for the participants, and in some events there has been breakout sessions and demos about particular APIs or tools, but in all cases the support has been targeted implicitly to technical users. Non-technical participants could be better supported, for instance through a short tutorial (workshop, introductory session) about how to extend and modify software using end user development strategies such as mashups, program modifications, model based development, or programming by example. Examples of challenges (for example previous hacks) that can be overcome without complex programming can be presented. A possible challenge for this strategy is the inherent time constrain of the hackathons that may be too limited for both learning and applying these strategies for new users.
- **Formal studies:** Finally, as part of our future work, we plan to more formally collect data at a Green Hackathon event. Instead of writing a position paper based on our "experiences", we would then be able to base a future paper on for example participant observations and semi-structured interviews with participants.

From an end user development perspective, the Green Hackathon events are interesting cases since they involves both non-professional developers working or helping out with computer hacks, but also from the other perspective the developers can be seen as non-professional sustainability practitioners working with sustainability questions. The whole hackathon concept relies heavily on the possibilities of accessing existing open data and software, and being able to quickly aggregate, integrate and present an end result (a hack) that can be relatively impressive. These ideas resonate with the EUD paradigm. The developments of powerful and easy-to-use web technologies are enablers that can allow hackathon participants to whip something useful and original together in just a day or two, and that provides affordances to non-expert programmers to create and extend software. Finally we argue that while these events have been open to a wider audience, the participation of non-programmers has been organized ad-hoc and it could be improved. Bringing in the approaches and discussions coming from end user development research can be a way of to formalize the participation of a broad set of expertises, and to empower interdisciplinary work and innovation in the events. Possible further research include how the non-technical participants roles can be formalized, and how to empower their role in the software development process using existing EUD paradigms and tools.

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