Digital Innovation: The Hackathon Phenomenon

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Innovation with digital technologies continues to emerge, but increasingly there are efforts to help *nurture* such innovation. A hackathon is an event in which computer programmers and others involved in software development collaborate intensively over a short period of time on software projects. These hackathons are encouraging of experimentation and creativity, and can be challenge orientated. From holding large numbers of these events, the *hackathon phenomenon* has emerged as an effective approach to encouraging innovation with digital technologies in a large range of different spaces (music, open data, fashion, academia, and more). We consider the origins and diverse format of hackathons, leading us to a high-level classification of the types of hackathons that occur. We also consider the results of a commercial survey conducted of a 150 hackathon participants, as well as two case studies of hacakthon events we have both observed and participated. We then discuss the potential of hackathons, including common general principles that we have observed in their format. We conclude by considering the potential and value of hackathons, especially in providing an opportunity for people to meet and collaborate to create new links in the medium to long term, beyond the short term focus of the event. Also, the potential for hackathons for networking in new spaces, including such as the emerging Culture Hacks.

1 Introduction

A hackathon has been described as a problem-focused computer programming event [11], as well as *a contest to pitch, program, and present* instances of prototype digital innovation (e.g. a prototype mobile application) [5]. They bring together programmers and others (interface designers, graphic designers and others) to collaborate intensively over a short period of time on software projects, increasingly to complete for funding and other forms of support (e.g. travel to attend events) for further development [11]. The *phenomenon* of hackathons has arisen from their growing global occurrence, having developed from their impromptu pizza parties origins to professionally organised corporate sponsored bespoke events. They have become an activity for many software companies, as well as cultural organisations and government agencies as an approach to encourage digital innovation with their assets and resources. This has lead to the rise of hackathon events being considered to have had a significant impact of the culture of digital innovation [11].

This work was supported by the Arts and Humanities Research Council, CreativeWorks London Hub, grant AH/J005142/1, and the European Regional Development Fund, London Creative and Digital Fusion.

The effectiveness of the hackathon phenomenon for digital innovation appears to stem from invested participation and sustainable innovation at individual events, combined with the holding of a large number of events. Changing participation from merely volunteerism to invested participation is generally achieved through focusing on issues of significance to the participants of the hackathon (e.g. social issues of concern such as open government, or a specific issue of interest to a community such as a Culture Hack), and/or the provision of an award or prize which adds a competitive element which encourages individual investment for person gain. The provision of a prize (often sponsorship for further development) potentially achieves the application of more resources to a challenge than the prize could fund directly (similar to the Google Lunar X Prize, etc). The relaxed organisational structure encourages participants to innovate and creates an environment that can sustain innovation (i.e. can manage the failure necessary for innovation to emerge). Also, the relative ease of hosting such events has allowed for many events to be held, and therefore for a range of expertise, experience and skills to be applied to range of different cultures. Equally, the ease with which they can be held, and the diversity of events that has emerged, makes understanding them challenging.

It is estimated that there is on average one hackathon a week in London, with hosts ranging from government departments (e.g. Hack the Government) to businesses (e.g. Cadbury), as well as cultural institutions (e.g. Hack the Barbican) and research networks (e.g. RCUK). The rise of the hackathons might appear inevitable, but may also have benefitted from being an effective form of *innovation under austerity*[7], which may also help to explain the apparent greater growth of hackathons in some parts of the developing world (e.g. Brazil, India, etc).

The remainder of this paper is structured as follows. In the following section (2) we briefly consider the origins of hackathons, including the format of the hackathon events in section 3. In section 4 we share our classification for hackathons, which we have found useful understanding the rise of hackathons. This is followed by our interpretation of a commercial survey of hackathon participants in section 5. We then summarise our case studies of hackathons in section 6, which we have attended to observe or been involved with for participant observation. We then discuss our understanding of hackathons, their rise, and our observations of best practises in hackathons. Finally, we conclude with our insights into the value and potential of hacakthons, before considering future work, including the importance of Culture Hacks.

2 Origins

The word *hackathon* is combined from the words *hack* and *marathon*, where *hack* is used in the sense exploratory and investigate programming (not as a reference to committing a cybercrime). The term appeared in 1999, seemingly arising independently from open-source software developers of the OpenBSD computer operating system, and Sun Microsystems (which has since been bought by Oracle) marketers. OpenBSD software developer's use of the term referred to a cryptographic development event held in Calgary on 4th June 1999, where small number of developers came together to avoid the legal problems arising from export regulations of cryptographic software from the United States of America (USA). For Sun Microsystems marketeers the usage referred to an event at the JavaOne conference 15th-19th June 1999, in which attendees were challenged to write a computer programme in the Java programming languages for the new Palm V handheld computer using the infrared port to communicate with other Palm devices and

connect to the Internet.

We propose that core elements of the hackathon model emerged from events known as local area network (LAN) parties. A LAN party is a gathering of people with computers or compatible computer game consoles, in which enthusiasts often share their modified computers (with extravagant aftermarket cooling systems, LED lighting effects, multi-display setups, and custom-built cases, and many other enhancements) to impress their peers. Highly caffeinated drinks, termed energy drinks, are considered popular at these events to improve concentration and stamina, since LAN parties often run into the early morning hours. Large parties can last for several days, and do not necessarily include scheduled breaks. Sleep is often compromised to play throughout the night and into the next day, although there is often a designated room separated from the LAN party to sleep. So, elements such as technology enthusiasts gathering together, the timeframe for the gathering, and the nature of pursuing a shared activity overnight, strongly appear to have influenced core elements of the hackathon model.

Hackathons for video game development are sometimes called *game jams*, apparently adopting a variant *design jams* (short collaborative events for designers and other creative professionals) rather than as a variant of the *jam* or *jamming* session in the musical context. We suggest this because in a *design jam* participants collaborate in the area of user experience challenges, which is a necessary and important part of computer game development. Otherwise, a jam or jamming session is a musical event, process, or activity where musicians play (i.e. "jam") by improvising without extensive preparation or pre-defined arrangements. Jam sessions are often used by musicians to develop new material (music), find suitable arrangements, or simply as a social gathering and communal practice session. Therefore, musical jam sessions could also be the basis of the term *games jams*, especially when considering the aspect of *play* being important in both, although the use of term of the *play* is considerably different. Furthermore, software developers will interact with interface designers, considerably more than with musicians (sometimes not at all if there is no original musical score), in the context of computer game development.

Hackathons are also known as a hackfest, which is an abbreviation of *hacking festival*. Also, as a *hack day* when the event is day in length. The term *codefest*, which is an abbreviation of *code festival* where code refers to *computer code*. It presumably arose in the hope of avoiding the negative connotations associated with the term *hack*. Technologically focused hackathons (rather than those focused on the application of a technologies to a social challenge or business opportunity) aimed at a specific application are sometimes known as *sprints* or *code sprints*. This is because of the potential for intensive computer programming over a short timeframe, which are therefore considered to be appropriately described as a *sprint*. This is often made possible by a specific pre-defined goal or goals which makes this *sprinting* (intensive computer programming) feasible, rather than an open-ended or exploratory hackathon, which would be expected to have considerable precursor activities such as software modelling, interface design, etc.

While the majority of hackthons are focused of software development, their definition does not exclude hardware development. However, hardware prototyping, beyond initial simulation and/or emulation, often requires considerable resources (large and expensive pieces of equipment or ventilation requirements) not available at a hackathons. Hardware development, similar to the software development of hackathons, therefore often occurs at hackerspaces. A hackerspace (also referred to as a hacklab, makerspace or hackspace) is a community-operated workspace, which typically have the large and expensive pieces of equipment required for hardware prototyping. They also usually include machining

equipment to shape raw materials that are preferable or required in hardware prototyping (e.g. cases for hardware prototypes). However, the increasing availability of flexible hardware prototyping technologies and approaches, such as Arduino[1], has made hardware prototyping at hackathons feasible, both in terms equipment practicality and reduced cost compared to the considerable resources that would otherwise be required.

During the 2000s hackathons became significantly more widespread, and began to be increasingly viewed by companies and venture capitalists as an approach to quickly develop new software technologies, and to locate new areas for innovation and funding. As the hackathon phenomenon has grew, many hackathons have benefited from professional organisation, utilising corporate sponsorships and investor-participation. However, this has occurred in some instances with tensions due to the socially-orientated innovation often prevalent in earlier hackerthons (e.g. civic hacking and data activism). Also, as hackerthons have become more wide spread, so has the participation of non-technical expertise, such as marketers, business developers, designers, etc.

3 Format

Hackathons typically start with one or more presentations about the event, including the challenge prizes if available. Aims or challenges can be gathered beforehand, and they can be shared or kept secret depending on the format of the event. Alternatively, they can generated at the event, or the event may be focused around a specific task. This is sometimes followed by suggestions or requirements for the size and participant types for the teams. Then participants suggest ideas and form teams, based on individual interests and skills. Sometimes they will pitch their ideas to recruit additional team members, because without sufficient technologists paper prototypes have to be utilised. Then the main work of the hackathon begins, which can last anywhere from several hours to several days. However, they typically last between a day and a week in length. For hackathons that last 24 hours or longer, especially competitive ones, eating is often informal, for which there are stereotypes of subsisting on fast food such as pizza and energy drinks. Sometimes sleeping is informal as well, with participants sleeping on-site with sleeping bags, or in provided tents at larger events. At the end of hackathons, there is usually a series of demonstrations in which each group presents their results. However, hackathons intended simply for educational or social purposes sometimes do not requires the participants to create viable software prototypes. There is sometimes a contest element as well, in which a panel of judges select the winning teams, and prizes are given. At many hackathons, the judges are made up of organisers as well as the sponsors of the event. However, judges can be made up of peers and colleagues in the field, typically in hacakthons without prizes. Such prizes are sometimes a substantial amount of money; a social gaming hackathon at the TechCrunch Disrupt conference offered US$250,000 in funding to the winners. Furtehrmoer, Mobile app hackathons like Over the Air, held at Bletchley Park, England, can see a large amount of corporate sponsorship and interest.

Hackathons require personalities comfortable with working informally with new people in small teams, as well as strong computer programmign skills. Also, the ability to work intensely under time pressure, and the ability to present one's work to others in a compelling way in a short time (i.e. pitching to potential investors). While not all participants will necessarily thrive in such conditions, these events have proven to be an

[1] An open-source electronics prototyping platform based on flexible, easy-to-use hardware and software.

affective approach to prototyping software.

4 Classification

Some hackathons have no restrictions on the focus or participants, being aimed at rapidly generating interesting software applications. However, the range of hackathons can be loosely grouped as being either tech-centric or focus-centric.

4.1 Tech-centric

Tech-centric hackathons focus on software development with a specific technology or of a specific application.

4.1.1 Single-Application

Single-application hackathons are focused on improving a single application. Such hackathons are popular for open source software (OSS) projects and rarely include a competitive element. Example applications would include a content management system, operating system and even the development of a new programming language. An annual meeting to work on the development of the OpenBSD operating system was a pioneering hackathon where the term may have originated.

4.1.2 Application-Type

Application-type hackathons focus on a specific platform (genre) such as mobile apps, video game development, or web development. Another example of the this type of hackathon is the Music Hack Day, which is for music-related software and hardware applications.

4.1.3 Technology-Specific

Technology-specific hackathons are focus on creating applications that use a specific language, framework or Application Programming Interface (API). So, for example, focusing on applications that make use of the API from a single company or data source. There have been hackathons devoted to creating applications that use a specific language or framework, such as HTML5 and Ruby on Rails. Platforms that have held development hackathons include Drupal and MediaWiki.

4.2 Focus-centric

Focus-centric hackathons target software development to address or contribute to a social issue or a business objective, and could even be considered *applied* hacakthons. For example, hackathons have been held to improve city transit systems. There have also been a number of hackathons devoted to improving education, including Education Hack Day and on a smaller scale, looking specifically at the challenges of field work based geography education, the Field Studies Centre hosted FSC Hackday. Random Hacks of Kindness is another popular hackathon, devoted to disaster management and crisis response.

4.2.1 Socially-Oriented

Socially-oriented hackathons aim to address or contribute to an issue of social concern, such as public services or crisis management. Examples of hackathons aimed at improving public services has included improving education, improving city transit systems and improving government. For the later, many have been specifically aimed at supporting open government.

4.2.2 Demographic-Specific

Demographic-specific hackathons are intended for programmers from specific demographic groups, such as women, students or teenagers. Their motivation stems from addressing perceived or recognised disparity in the inclusivity of the programming profession (e.g. gender imbalances), or the desire to encourage and support the next generation of programmers.

4.2.3 Company-Internal

Some companies, such as Google and Facebook, hold company-internal hackathons to encourage new product innovation by their engineering staff. For example, the *Like button* of Facebook was created as part of one of their company-internal hackathons.

5 Survey

TokBox, a subsidiary of Telefnica[6], in 2012 asked 150 hackathon participants from across the United States of America (Dallas, Portland, Boulder, Chicago, Las Vegas, Seattle, DC, and Boston, among others) their opinion about different aspects of the hackathons they attended [8].

The majority of participants (70%) had attended a hackathon before, which suggests a significant proportion were interested beyond the results of the specific hackathon they were attending. As 30% of participants were attending for the first time it also suggests that the hackathons were able to attract a significant proportion of new participants. Most interestingly this suggests the growing number of hackathons creates *hackathon circuits*, an established itinerary of hackathon events.

5.1 Gender Inclusivity

Female attendants are significantly underrepresented, making up only 11% of attendees. There are considerable anecdotal comments regarding why this may be, ranging from the perceived unsociable nature of the events, such as the lack of sleep, to the un-constructive attitudes of predominantly male participants, such as stereotyping female participants. However, it should be noted that female attendance is similar to female employment in the technology industry of 12.3% [1], and the number of female graduates 11.8% [12] in computer science. So, it would appear that hackathons are simply no better at addressing the problems of female inclusiveness in technology development than the technology industry, computer science academia and wider society. Therefore, we would expect that the reasons of female under representation at hackathons is similar to, and connected to, the reasons for female under representation in the technology sector and computer science academia.

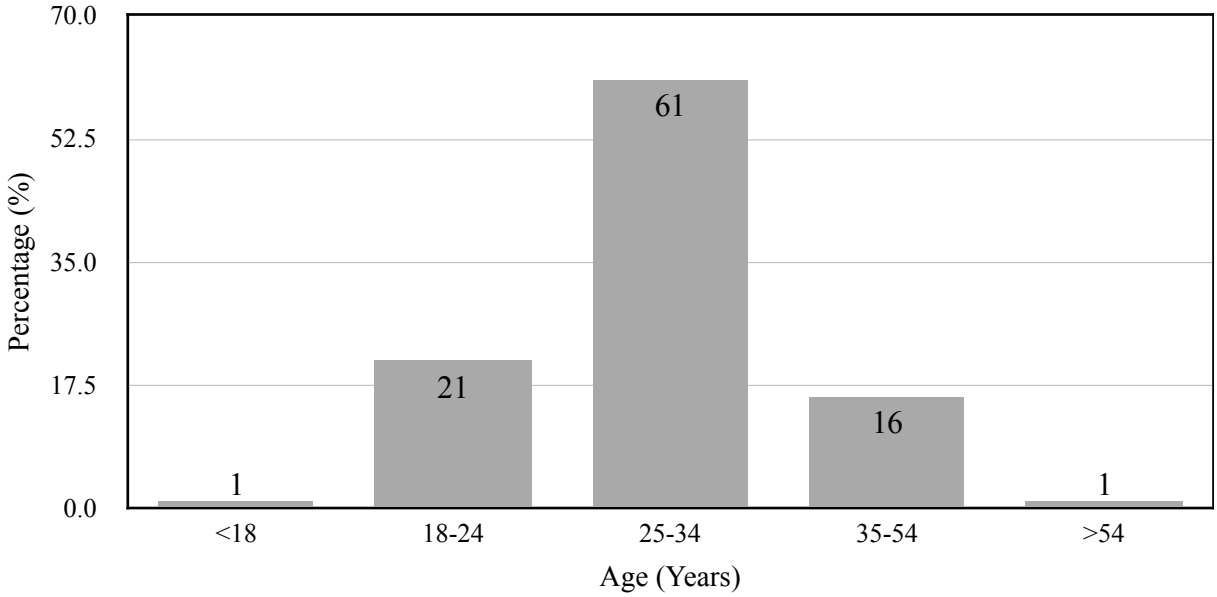

Figure 1: *Graph of the Age of Participants at Surveyed Hackathons*

5.2 Age Inclusivity

The age of attendees varied, with 61% being between 25 and 34, and the remainder as shown in Figure 1. While the age brackets chosen are not uniform, the majority being within the age of 25 and 34 years is unsurprising given the age inequality reported in the technology sector. According to a 2011 survey by the Information Technology (IT) recruitment consultancy Greythorn [2], three out of every four IT professionals believe that the industry discriminates against older workers, with just 30% of employees over 50 saying they felt secure in their jobs. So, while one might expect aspects of the format of the event to favour younger participants, such as weekend attendance (conflicting of typical family time) and working overnight (less stressful to younger participants), it would appear that in terms of age distribution that hackathons are a microcosm of the wider technology sector.

5.3 Non-Technical Inclusivity

The majority of attendees, 77%, described themselves as software developers, and 23% described themselves as non-developers. The classification of non-developers includes a range of expertise, which is often very important to the success of focus-centric hackathons. Tech-centric hackathons would be expected to operate effectively with only software developers, especially collaborative hackathons with significant and clearly defined technical goals, i.e. non-developers being between 10% to 20%. However, we would consider that focus-centric hackathons would be expected to have between 20% and 50% non-developers. This is because any lower a proportion would risk teams consisting of only software developers, which in focus-centric hackathons would likely limit there ability to create a *software demo* with relevance to the focus of the hackathon. Similarly, any higher a proportion would risk teams without any software developers that would likely be limited to *paper prototypes*, which would be more akin to a *design jam*. This is problematic because of the often *demo or die* nature of hackathons, especially if they are challenge oriented hackathons with an assessment for prizes at the final stage.

While hackathons remain dominated by those with technical expertise, which is to be expected. The proportion of developers to non-developers (77%, 23%), with our suggested compositions (above) for tech-centric (85%, 10%) and focus-centric hackathons (65%, 35%), would suggests that around 50% are focus-centric hackathons. This is consistent with anecdotal observations of the growth of focus-centric hackathons, in for example the events of the Meetup.com group *Hackathons and Jams UK* [9].

5.4 Reasons for Attendance

When participants were asked why they attended the two top reasons were learning (86%) and networking (82%), which is summarised in Figure 2 along with the other reasons given. The first reason is to be expected given that the nature of software development has a strong element of life-long learning, arising from the ever-continuing emergence of new technologies that often come to replace existing technologies. The second reason suggests that our proposed interpretation of *hackathon circuits* offers an itinerary of events for networking with the technology sector.

The next highest reasons given were *changing the world* (38%) and *winning prizes* (28%). The first is representative of one of the aspects in the origins of hackathons, the aim of achieving social betterment through hacking code (software development). The second is representative of the more recent commercial influences which have defined a genre of challenge-oriented hackathons centred around personal opportunity. So, while it appears that commercial involvement to support challenge-oriented hackathons has helped the *rise* of hackathons, certainly adding the emergence of the *hackathon phenomenon*, it has not yet come to dominate as a motivation to participate in hackathons.

While the reason of *free pizza* was the next most given reason at 27%. So, this result and range of other more popular reasons strongly suggest that stereotype of hackathons centred around free pizza is representative. Other hackathons we have observed or been involved with have also had alternative eating arrangements. For example, the 2013 Hack the Barbican hackathon [10] eating arrangement was *pot luck* after one of the participants stated they were not the stereotypical pizza-eating hacker, while the 2012 NEM Summit

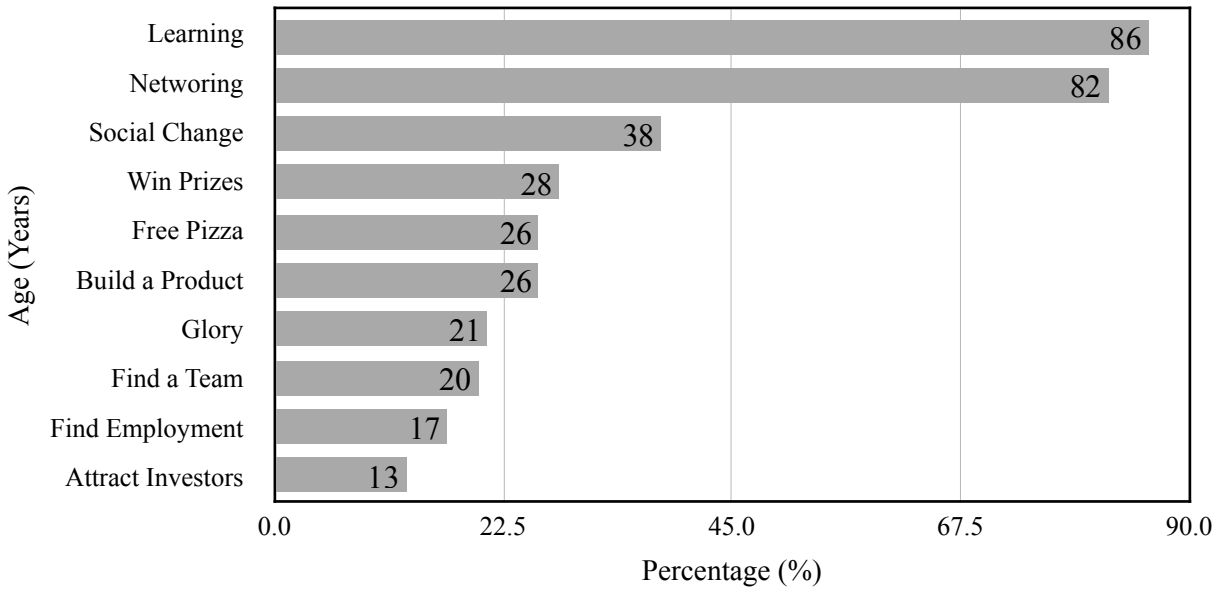

Figure 2: *Graph of the Reasons for Attendance at Surveyed Hackathons*

hackathon was provided with a range or *finger food*, and fresh oysters thanks to the integration and access with the main NEM Summit to which the hackathon was attached.

Other reasons given including building a product at 26% which suggests that majority of participants view hackathons as a prototyping, rather than traditional software development cycle for building a product.

6 Case Studies

The first case study was conducted through participant observation with the Urban Prototyping London (UPL) hackathon, in which we were involved with many aspects of the organisation and management of the event. For example, we were involved with arranging and providing the data sources which were utilised at the event. The second case study, the hackathons at the NEM Summit 2013, was conducted through observation, to provide a contrasting perspective to participant observation with the first case study. Therefore, we gained a perspective from *inside the box* at the UPL, while a perspective from *outside the box* with the NEM hacakthon.

6.1 Urban Prototyping London

Urban Prototyping, an initiative of the Gray Area Foundation for the Arts (GAFFTA), explores how technology, art and design can serve as new tools for civic participation in a digital era. The Urban Prototyping London hackathon was organised by the RCUK Digital Economy Programmes Sustainable Society Network+. It was a focus-centric hackathon focused on innovation and digital technology in urban spaces, including hardware hacking (e.g. Arduino) as well as software hacking. It started with introductory presentations, followed by information on the challenge spaces and prizes. Prizes included an all-expenses paid opportunity to present at the Mobile Expo Asia in Shanghai, as well as sponsorship prizes by the GSM Association and Intel.

It was a weekend hackathon, with participants given 48 hours from friday evening, with no conditions or suggestions placed on the size or constitution of their teams. The organisers provided snack food items and soft drinks, while participants were free to make their own sleeping arrangements. The size and constitution of teams varied, ranging from teams consisting a single technologist to large teams of technologists (over 10 participants) engaging in software hacking. There were also mixed teams of designers and technologists engaging in hardware hacking, as well as small teams of designers engaged in paper prototyping.

At the end of hackathon participants were invited to present and demonstrate their efforts. Notable contributions included an emergency contact app developed by a technologist working alone, a paper prototype for a website to share food developed by a team of two designers, and a system that identifies crowds over google maps via twitter contributions developed by a large team of technologists. The judging panel then retired to consider the winning teams, with one of the organisers commenting that they were taking their time as they debated who would fund which team as they were so impressed with the contributions.

6.2 The NEM 2013 Summit

The NEM hackathon is in its first year, and was initiative of the ICT-ART EU project, which aims to explores how technology and art can come together in different ways. The hackathon was organised as part of the NEM Summit, although distinctly separate. It was a focus-centric hackathon (rather than tech-centric hackathon) focused on innovation with digital technology in new media, such as social TV and smartphones, being primarily about software hacking. It started with introductory presentations, followed by information on the challenge spaces and prizes. Prizes were mostly cash awards, as well as possible sponsorship for future development.

It was a shorter hackathon, with participants given 24 hours after some time to get to know one another. Conditions were suggested on the team size, around 4 per team. Conditions were also places on the constitution of their teams, at least one artist and one technologist, which I believe contributed to the high quality of the contributions for a focus-centric. There were also encouraged to create teams with both English and French speaking participants. The organisers provided food, soft drinks and coffee. Wine was seen on some of the tables, which would be considered unusual for the typical hackathon, showing a more progressive perspective to arrangements and recognising that not all hackers (or contributors) only eat pizza and soft drinks as the known stereotypes suggest. Participants were left to make their own sleeping arrangements, and inflatable mattresses were utilised. The size and constitution of teams varied, ranging from two to six, but all having at least one technologist and one artist. So, there was software hacking in favour of any paper prototyping.

At the end of hackathon participants were invited to present and demonstrate their efforts. Notable contributions included an app to help one learn a language as you explore a new city, and an application and app combination that allows participants of a concert via their smartphones to control aspects of a DJ's performance (application). The judging panel then retired to consider the winning teams, which included considering the practicality of the contributions, and commented that they were impressed that the contributions could be created in such a short space of time.

7 Discussion

The hackathon as an activity has many different versions and as such is not limited to a particular or inherent ethos or ideology. However, the are some inherent elements that are universally required, such as collaboration. So, while it would be difficult to provide a universal set of *best practices* given the range of hackathons for hacakthons across the board, there is some general principles that have been suggested [3] and that we have observed:

- Events are output-oriented.
- Events should be inclusive.
- Learning and sharing are important.
- Failure is valuable too.
- Flexible seating, WiFi and electricity are required.

- Whiteboards and windows with an inspiring view are preferable.
- People should be allowed to self-organise into groups. Sign up sheets and web sign up is best avoided.
- While group leaders should be encouraged, they should not be mandated.
- Participant teams should be encouraged to report failures and future roadmaps, as well as accomplishments.

Hackathons can potentially suffer from a lack of institutional memory, which is collective set of facts, concepts, experiences and know-how held by a group of people. This is because it requires the ongoing transmission of these *memories* between members of the group. This, combined with a high frequency of events can dilute their effectiveness. For example, if the pool of participants is small relative to the frequency of events this can lead to innovation fatigue, as well as physical fatigue (considering the potential to attend weekend long hackathons once a week). Also, it can to participants not engaging in significant software development at hackathon events, but rather having a prototype and presentation prepared before the event. This can often be determined if the presentation or the demonstration appears too polished, especially compared to those that have been created within the often short timeframe provided. Also, such participants will often be observed to have been working by themselves and not in a team. Sometimes, they give the reason that their intended prototype that they were developing at the hackathon proved unviable due to technical challenges. However, to can be difficult to be certain as there sometimes participants who work individually, and sometimes participants/teams are unable to overcome technical challenges that arise in the limited timeframe of a hackathon.

We believe it is a mistake to view hackathons as a platform for building a concrete product rather than concepts, because more structure to their organisation would be required and this would diminish the agency and representation of participants. Furthermore, the hackathon is an approach to organisation that is contextual, and that can be suited towards unique purposes depending on the focus. The variety of options between those purposes and motivations reveal the tensions that exist when we try to think of the hackathon as having a singular format and structure, and so organisers must try to align the way the event is held with their motivational values. Furthermore, it could be argued that the most important output of a hackathon is the community that develops as people experiment with each other from one event to the next.

8 Conclusions

The greatest potential and value of hackathons is in providing an opportunity for people to meet and collaborate to create new links in the medium to long term, rather than the short term focus of the event. Generally, the success at the event is not realised until later, given that it is essentially a prototyping exercise technically speaking, but it is similarly a *prototyping* exercise of new working and personal relationships/collaborations for the participants. Furthermore, the hackathon phenomenon, or the hackathon circuit, can even be of considered to operate at an international scale. So, if the value is not limited to just the outputs of the events as we suggest, but also the in the connections that are established (which are sometimes funded by the prizes), it provides a unique networking opportunity. This is especially true if looking for opportunities in new spaces,

for which existing connections may not be related and therefore recommendations for contacts limited. Also, while the hackathon is far more intensive than other networking event, this provides the opportunity for significant and substantial *connections* to be established rather than for just mere contacts to be formed.

Hackathons and its variants are increasingly emerging in the available literature, both as reported sources of innovation and as the topic of field reports [4]. However, there is still considerable future work to be done in understanding hackathons. For example, in better understanding gender inclusivity, both to confirm and go beyond are observations and interpretations. So, better determining if gender inclusivity at hackathons does stem from the gender inclusivity prevalent in the technology industry, undergraduate computer science participation and wider society. There is also potential future work to be pursued in understanding focus-centric hackathons that making use of culture resources and assets, known as Culture Hacks. Especially, considering the potential we have identified in hackathons as an effective alternative approach to networking generally, and specifically across different expertise and industries in applied focus-centric hackathons.

Acknowledgements

We would also like to thank the Sustainable Societies Network+, of the RCUK Digital Economy Programme, for the opportunity to participate in the Urban Prototyping London hackathon.

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