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EveryAware

Enhance Environmental Awareness through Social Information Technologies

http://www.everyaware.eu

Seventh Framework Programme (FP7)

Future and Emerging Technologies of the Information Communication Technologies (ICT FET Open)

D6.2: Report on dissemination strategies and participation fostering activities

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Executive Summary

The main aims of Work Package 6, of which this report forms a part, are two-fold – **dissemination**: ensuring that the results of the project are disseminated to beneficiaries including the scientific community, the public at large, engineers and **engagement:** recruiting and engaging participants for the various EveryAware Case Studies described in [UCL, 2012]. This engagement process is, of course, by its very nature a disseminative activity.

Whilst scientific and policy dissemination are fundamental to any research project, they are perhaps more appropriate towards the end of the project, with a focus of sharing the results of the research as a whole. Therefore, this document focuses on the latter of the two processes **engagement** and reports on the dissemination strategies and participation activities carried out to support two EveryAware Beta tests and an on-going large-scale case study (as described in [UCL, 2012]). These activities of necessity take place from the outset of the project, in order to ensure that participants are recruited as required, in particular given the relatively long time-span required to recruit members of the general public. The research questions for these participatory activities revolve around the motivation of the participants as well as any changes that occur as a result of taking part in the activities and a key goal is to evaluate a range of different engagement tactics for recruiting participants in environmental monitoring.

To date, participant recruitment and engagement for two beta tests has been carried out. Firstly, members of the public were recruited for a noise monitoring exercise using the WideNoise application (app), where the test had the main focus of validating end to end integration of the EveryAware platform and the usability of the pre-existing WideNoise tool. Secondly, interested participants have been recruited for preliminary air quality monitoring tasks using low-technology tools, in anticipation of the availability of the EveryAware Air Quality sensor box. The outcome of both these tests has informed approaches to a first large-scale case study using the WideNoise app (see [UCL, 2012] for a full description of the app), focused around Heathrow airport and described separately in this document. This large-scale case study was anticipated in date due to interest from local groups in the area and has been designed to allow the comparison between a hands-on, issue based campaign method and a hands-off, crowd-sourced model of participation, as well as to compare the impact of different data capture protocols on resulting data coverage.

Context of This Report

This document describes the processes followed to recruit, and then maintain engagement of, participants for EveryAware. As part of this process, it has also been possible to undertake preliminary investigations into changes in behaviour resulting from participation. Importantly, the document should be read in close association with [UCL, 2012] which describes the usability studies carried out on the WideNoise application. As will be seen, the usability and affordances of the WideNoise tool are important for the level of engagement possible with public participants.

Summary of Significant Results

The results presented in this document highlight the interest shown by the general public in environmental monitoring, with 23777 geographically-referenced noise points captured and significant effort invested by seven community groups in the low-technology based air quality monitoring activity. In both cases, participants have invested time and changed their daily routines. Key findings include:

- It is not possible to fully determine the impact of a single method of participant recruitment, as methods are rarely used in isolation, given that the main aim of recruitment is to reach as many potential participants as possible. Indeed, a mix of traditional methods (e. g. flyers) and modern methods (social media, news paper and television articles) appear to yield good results, although this is context-specific. Paid-for advertising, on the other hand, seems to yield far fewer results than expected.
- The importance of working with a target group having an interest in the environmental topic in question should not be underestimated. Face to face meetings and a specific geographical (and potentially time-restricted) focus appear to increase both the overall number of participants and their level of engagement in the project and time committed.
- The usability of the tools (see [UCL, 2012]) is important to maximize uptake. Tools should be ideally devised in conjunction with end users, and should fit into their daily routine where possible.

Further research during the remainder of this project and beyond will deepend the investigation into participant recruitment, ongoing engagement during longer term projects and any changes in behavior. Of particular interest to the team is research into obtaining optimal data coverage to permit interpolation from the data points captured. Continual monitoring (as opposed to the point-based data capture trialled to date) appears to be important in this case. Equally, further research is required to determine whether specific, targeted data capture protocols (*go to point X at time Y*) yield better coverage than more general instructions (*capture data outside*), even though they involve more active disruption of participants' daily routines.

It is important to note, of course, that this project is only partially completed, and that the findings described here are at best indicative, in particular given the relatively short period of time for which the general public has been engaged. However, the range of analysis undertaken and results presented strongly illustrate the potential of the methods employed by the EveryAware team to answer the questions posed at the outset of this research. In many cases, clear trends appear to have emerged. However, further longer term engagement is required to validate these interim findings.

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Chapter 1

Recruitment, Participation and Engagement

The literature on participation and engagement is very broad and extends from the theoretical level on what participation means and the political philosophical justification for it, to institutional policy down to application in a large variety of different disciplines. This short review aims to provide a brief survey of how participation is conceived at these different levels with particular focus on the relevance for EveryAware and environmental monitoring activities. This literature review builds the argument for an expanded notion of participation and behavior change which are at their core focused on democratization and debate. Establishing this focus on debate and reflection was key for the shaping of the ongoing large-scale participation case study, the interim results of which are presented in this document.

1.1 Theoretical - Participation Beyond Transactions

Participation is seen generally seen as a public good, with the assumption that

> "The more citizens deliberate, the more informed, interested, participatory, efficacious, trusting, supportive of democracy, and sociotropic they become." [Luskin and Fishkin, 2002]

This association between participation, deliberation and democracy, recurs throughout the literature on participation and the public sphere [Habermas, 1985]. According to the Oxford English Dictionary, democracy is defined as

> "Government by the people; that form of government in which the sovereign power resides in the people *as a whole*, and is exercised either directly by them (as in the small republics of antiquity) or by officers elected by them. In modern use often more vaguely denoting a social state in which *all have equal rights*, without hereditary or arbitrary differences of rank or privilege"

As a result, participation in decisions that influence one's life is seen as necessary element of democratic decision making [Brodie et al., 2011]. Participation such as that described above can be considered to be the strongest notion of a participatory democracy and is an ideal rather than achievable in practice. In order to understand a weaker notion of participation, we need to look at a more colloquial notion of democratization: making a process or activity that used to be restricted to an elite or privileged group available to a wider group in society and potentially to all. For example, with mobile telephony now available across the globe, the statement *mobile telephony has been democratized* or *there is a marked increase in the participation in mobile telephony*

aims to express the fact that, merely three decades ago, only the rich and powerful members of Western society had access to this technology. However, even this colloquial concept, where using a mobile phone is democratization, does not capture the structurally transformative nature of democratic participation, which is about social and collective behavior.

> "Democratization has a deeper meaning in respect of making technologies and processes more accessible to hitherto excluded or marginalized groups in a way that assists them to make a change in their life and environment. Democratization evokes ideas about participation, equality, the right to influence decision making, support to individual and group rights, access to resources and opportunities" [Doppelt, 2006].

Democratic participation, then, cannot be reduced to measurable transaction metrics. A good illustration of this is the Open Street Map (OSM) project, where thousands of participants collaborate online and in local groups to create a free street map of the entire world [Haklay, 2010]. While OSM is often portrayed as an example of crowdsourcing, the actual internal operations of the community are much closer to democratic participation, where members argue about rights and resources. This is best illustrated by the episode where OSM had to transition to a new data license. Rather than a simple process of rubber stamping, this episode triggered a bitterly fought battle amongst the members over the wider political and cultural implications of the change of data license. The resulting dispute has lasted for four years and is still not completely resolved. The theoretical literature suggests that it is the strong engagements and disagreement of participants which is indicative of the democratic concept of participation [Mouffe, 2000].

Evidence of the tensions between an expanded and narrowly defined transactional concept of democracy can also be seen in the literature on behaviour change. This concept, which at its root also aims towards a greater good, does so by focusing on the behaviour of individuals and how this can be nudged towards more sustainable lifestyles [Barr et al., 2011]. In this rhetoric, environmental issues are seen in terms of individual decisions, and a conflict emerges between the greater good and the individual who is seen as not contributing democratically. In contrast [Kenis and Mathijs, 2012] suggest that this focus on it being the individual who should change is a misrepresentation of agency and power. They suggest that existing social, political and technical structures are the repositories of power which are disabling collective change.

> "By leaping too directly from the knowledge of the nature and effects of the environmental problem to the level of solutions, the individual behaviour change approach risks sidestepping not only the human-societal context within which the problem arose, but also the possibility for people to engage in strategic reflection themselves and to draw their own conclusions on the kind of actions required. In other words, it risks sidestepping the possibility for people to be really em'power'ed citizens and potential subjects of change" [Kenis and Mathijs, 2012].

This call [Kenis and Mathijs, 2012] for collective strategic reflection links well with Doppelt's [Doppelt, 2006] belief in the democratizing power of technologies to support empowered citizen groups. If we follow this reasoning then the role of research projects like EveryAware, is support communities with environmental monitoring tools and services, while allowing them to define their own goals and notions of change.

1.2 Policy - Participation in Environmental Decision Making

Note: This section is based on [Haklay, 2009]

While the previous section explored the conceptual level of participation in the democratic processes, for EveryAware the area of environmental decision making is especially important. In this

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domain public participation has been considered a central pillar of environmental democracy. From the US National Environmental Policy Act (NEPA) [NEPA, 1969], enacted in 1969 and recognized since, as one of the key legislations of that period (Buck 1991 in [Michaels and Furuseth, 1997]), through the declarations of international environmental conferences (such as [UN Stockholm Conference, 1972],[UN Rio Conference, 1992],[UN Johannesburg Summit, 2002]) to regulations, reports and academic discussions – participation is always described as central to decision making.

The early years of political awareness of environmental problems was marked by a differentiation of the role of experts and the public. The Stockholm Declaration (1972) [UN Stockholm Conference, 1972], which came at the end of the first UN conference dedicated to environmental issues, differentiated between providing information to the public for the sole purpose of educating the populace, while the serious matters of making decision are left to the experts and the scientists. This technocratic view of dealing with environmental problems changed dramatically in the following decades due to the trend towards improved citizen participation in environmental decision making. The change occurred rather gradually. For example, in the United Kingdom, while the Town and Country Planning Act of 1947 introduced public scrutiny of changes in the built environment, clearer guidelines for public scrutiny and involvement were added in the 1970s and the 1980s [Rydin, 1998]. Another example is the development of public involvement mechanisms in environmental impact assessments in many countries, which occurred during the 1970s and 1980s [Gilpin, 1995]. These changes accelerated in the late 1980s with the publication of *Our Common Future* [WCED, 1987],[Brundtland, 1987], and the acceptance of the Sustainable Development principles at the Rio conference.Sustainable Development calls for inclusion of environmental, social, economic and political considerations in decision making, and therefore participation from a range of stakeholders is necessary [Rydin, 1999].

Yet, in the process that led to the United Nations Conference in 1992 and the formulation of Principle 10 of the Rio Declaration on Environment and Development [UN Environmental Programme, 1992], access to environmental information and participation became inexorably linked. Principle 10 was created as a result of an initiative by Northern European countries such as the Netherlands and Norway to promote a *Charter of Environmental Rights and Obligations* during the Rio conference which was supposed to include

> "the right of access of individuals to environmental information, the principle of the participation of citizens in decision making affecting the environment, and the right of access to administrative and judicial proceedings" [Pallemaerts, 1992]

The initiative failed, and Principle 10 is a watered down version which carries through the spirit of the Charter.As a result, access to environmental information became a necessary element for public participation in environmental decision making, as Principle 10 of the Rio Declaration [UN Environmental Programme, 1992] clarifies:

> "Environmental issues are best handled with participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided."

While there is significant evidence that both public access to environmental information [Haklay, 2002],[Haklay, 2003],[Rowan-Robinson et al., 1996],[Alabaster and Hawthorn, 1999] and public participation in decision making [Harrison and Haklay, 2002],[OECD, 2001],[Lowndes et al.,

2001],[Pratchett et al., 2001] are fraught with difficulties, the coupling of access to information as a preliminary step towards participation is rarely questioned. Principle 10 typifies this coupling – while the first sentence focuses on the value of participation, it is immediately followed by a declaration that puts access to information before *the opportunity to participate*.

The ordering of access to information as a necessary prerequisite for participation (and not just as enabler) is unique to environmental decision making. Furthermore, the level of attention that is given to information in the environmental area and other aspects such as the demand for active delivery, or the rights of Non-Governmental Organizations (NGOs) to participate in decision making, signals a qualitatively different role of information within environmental decision-making processes.

Further evidence of the difference between the environmental field and other policy areas is provided from the debate around the concept of 'evidence-based policy', which emerged in the 1990s, with the call to use research results in the process of policy making [Packwood, 2002],[Clarence, 2002]. Evidence-based policy assumes a linear connection between research and its results to the formulation of policy [Black, 2001]. It is recognized as an ideological approach that views effectiveness as quantitative measures and credible evidence as complex statistical analysis [Packwood, 2002]. However, while in fields such as health or education the need for evidence-based policy and its relevance are challenged, it seems that since its inception the environmental field accepted the 'evidence-based policy' approach as the central framework for decision making. As a result, environmental decision making is constructed in scientific terms, and only scientific arguments carry weight within such processes [Eden, 1996] (p183). identified the exact problem, noting that

> "Policy tends to assume that providing environmental information and education will secure behavioral change, when behaviour is in fact intimately dependent upon public interpretations of the issues."

However, while Eden discusses significant environmental policy issues – such as the depletion of the stratospheric ozone layer or global warming, the primacy of access to environmental information over participation indicates that the scientific framing of environmental issues is happening at all scales – including in decisions such as the provision of a license for a hazardous chemical or changes to the operating regulations of a local airport.

1.3 Applied Participation Concepts in Citizen Science

There are many examples of researchers of user-generated content using the language of participation and engagement. In this model of participation:

> "we must understand what motivates content contributors, and identify which motivations are associated with high low levels of contribution" [Nov, 2007]

These studies attempt to find proxies as metrics for engagement. In the heavily cited paper, *What motivates Wikipedians?* [Nov, 2007] , time spent by users contributing, is used as a proxy for the intensity of engagement. In turn the actual motivations are encapsulated as single word categories, *Fun, Ideology, Values, Understanding, Enhancement, Social, Career, Protective* [Nov, 2007].

Similar approaches are used in the study of Volunteered Geographic Information (VGI, which includes projects such as OSM described above), where detailed analyzes of the database metrics such as number and time of contribution are used as proxies for longevity of engagement [Neis and Zipf, 2012] In addition the spatial dimension of VGI allows spatial metrics such as size of activity area to differentiate between different types of user groups [Neis and Zipf, 2012].

Yet, as argued earlier, information plays a different role within environmental decision-making than these open-source user contributed examples. While motivation is certainly studied within Citizen

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Science [Rotman et al., 2012], it is seen in relation to accuracy and data collection protocols [Cohn, 2008],[Silvertown, 2009],[Williams et al., 2012]. These accuracy issues of reliable user-generated data are given further weight in the literature on pollution monitoring [Ottinger, 2009]. Despite these concerns, there are studies that demonstrate that it is possible to carry out large scale monitoring of environmental pollution by citizens at high accuracy levels [Santini et al., 2009], [Stevens, 2012]. In relation to accuracy, the recruitment of participants is another one of the issues addressed in the applied participation literature [Reddy et al., 2010], [Lane et al., 2010]. Most of the engineering led literature has few guidelines on how recruitment should take place. However, there are some examples such as 'A Survey of Mobile Phone Sensing' [Lane et al., 2010] which provide a help concept of three different levels of participant sensing, with people being recruited at the individual, group and community levels.

wide range of methods exist to identify and recruit participants, including:

1. Twitter and other social media (online) - particularly useful to reach a large number of people without having direct face to face contact.
2. Attendees at a topic-specific conference - a smaller group, but perhaps having a more direct interest in the environmental research in question, as well as benefiting from face to face contact with the research team
3. E-mail and targeted e-mail - again, benefiting from an online approach and the ability to reach larger numbers of people. If specific mailing lists are targeted, it provides a more direct targeting of people who have expressed an interest in a specific topic or are members of a particular group
4. Business cards or flyers - take up relatively little room and can point people towards further information on line, but require physical distribution
5. "Ad van" - placing an advertisement on the side of a van, which is then driven around the neighborhood of interest. This low-tech solution has the potential to reach a wide range of ages resident in a specific area, but can be expensive.
6. Working with an action or interest group - identifying a local group with an interest in the environmental issue in question provides a method to rapidly reach participants who perhaps have a higher level of motivation to engage than the general public, as well as having an increased awareness of the issue at hand.
7. Community engagement officer - identifying one or more members of a specific community group who can act as advocates for the research activity. This method has the advantage that the officer has detailed knowledge of the group and can offer advice on how best to frame the project. Additionally, the officer is known and trusted by the group, facilitating a more rapid establishment of trust between the researchers and the community.
8. Workshops - again, these offer the opportunity to target all members of the public in a specific neighborhood. However, timing and activities are key in attracting participants.
9. Television - either via a news article or other publicity - permits a very wide audience to reach, who will again consist of a wide range of age groups. This technique could be particularly effective if combined with a subsequent face to face activity such as a workshop.
10. Print publicity - advertisements in local press may be relatively cheap and offer the ability to reach audiences that do not necessarily have access to technology.
11. Online media publicity - offers the same advantage as social media, with the additional benefit that advertising can be targeted, for example, to appear following specific search terms.

Naturally, the selection of an appropriate method or group of methods will differ for each case study. For example, taking a highly technical, online, approach may not be appropriate to recruit participants with low levels of computer literacy (i. e. the digital divide is an important consideration). Equally, flyers provide a method to target a geographically constrained community (i.e. a small area) but may prove to be expensive for wider distribution. Online methods, including social media, may prove to be more efficient for a younger audience. Following on from this, the impact of individual methods cannot easily be measured, as it is evident that to maximize participant numbers and ensure that a wide range of age groups and interests are represented, these methods are rarely used in isolation of each other.

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Chapter 2

The Beta Case Studies

A total of two Beta case studies have been completed on target, the first relating to noise monitoring and the second to air quality. They offered the EveryAware team the opportunity to gauge the success of various recruitment and engagement techniques for both noise and air quality studies. The results of these studies have provided input into a large scale noise case study which is currently being carried out in the Heathrow area of London, the location of the UK's busiest airport (interim results from this case study are given later in this document, see Section 3).

This section describes the context of the Beta case studies, with specific focus on the recruitment and engagement techniques and methods used in each case. This is followed by a brief overview of the general methods utilized to understand the success or otherwise of each of these processes, and a summary of the results obtained in each case study. The outcomes of the case studies, from the perspective of the communities, are also reviewed.

2.1 Engaging Participants for the Beta Case Studies

2.1.1 Best Test 1 – Recruiting Participants for Noise Monitoring Activities

The aim, in terms of recruitment and participation, of the beta test on noise monitoring, was to test a range of very targeted recruitment methods including e-mail and flyers, within the context of a specific event. Additionally, this test aimed to receive informal feedback on the usability of the pre-existing WideNoise application and validate the end-to-end integration of the EveryAware platform (the results of these tests are described in [UCL, 2012]).

The Beta test was held at the London Citizen Science Summit in February 2012 (16^{th}-18^{th} February) (Figure 2.1 shows the flyer), with the aim of recruiting the conference delegates (around 170 in total) by asking them to download the WideNoise application and use it to carry out noise mapping around the conference facilities and in the surrounding area.

To recruit participants, an email was sent to all the delegates before the start of the conference. This was repeated every morning over the course of the three day conference. On the first day of the conference, a short presentation was held by one of the UCL project team, inviting people to participate. After the presentation, custom business cards with links to the WideNoise application were distributed to all the delegates and the UCL project team were on-hand to answer questions and help with the installation of the application on people's mobile phones. The summit also included a talk by the leader of the EveryAware project (Professor Vittorio Loreto) on the 18^{th} February, which was reported as part of the summit online blog [ExCiteS, 2012].

Additional publicity was generated via various articles related to the Summit, which appeared in

Figure 2.1: Citizen Science Summit flyer.

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online press during and following the activity. Large numbers of tweets were also generated as the activity progressed. One such example which mentions WideNoise directly is a blog post by Mapping for Change (EveryAware's partner with specialization in engagement of participants). This is shown in Figure 2.2, and included a photo of the WideNoise app itself, as well as a map of the results shown on the EveryAware WideNoise website.

Similarly, the project was covered on Grid Cast, which is a blogging site with authors who specifically cover e-science activities around the world. The following text appeared on this site during the summit:

> "The last project was EveryAware presented by Vittorio Loreto from La Sapienza University of Rome. It is a platform that integrates objective and subjective monitoring to improve awareness and possibly change behaviour. They combine various technologies from sensor boxes to smart phones with their flagship project being *WideNoise*. Measuring actual noise (objective) and a user's prediction (subjective) it helps build up a noise map of the area but also engage the user in what the noise levels are around them" [Gridtalk, 2012]

Taking a more international scope, although without a specific focus on WideNoise as such, articles about the summit appeared in Science [Austen, 2012], Nature [Rowland, 2012] and in China Dialogue [Geall, 2012] – shown in Figure 2.3 below. While it is not possible to directly link these to downloads and usage of the WideNoise app, it could be suggested that the general publicity surrounding the event may have increased interest in WideNoise.

2.1.2 Beta Test 1b - *Se Giochi Fai Scienza* ("You're Playing – It's Science")

A second event, again focusing on noise measurement amongst other activities within the context of a specific event, was organized in Rome, Italy, on the 9^{th} June 2012. This event formed part of an activity held within a book store in Rome, the "Libreria Assaggi", Figure 2.7, which is a scientific bookshop. It permitted users to capture noise data in the surrounding streets and visualize the results on a large screen inside the store. In conjunction with this activity, which involved the general public, members of the project team set out to create a systematic noise map of the area surrounding the book store. The event was publicized via Twitter (Figure 2.4, Facebook and other online web sources, as well as having a dedicated website (Figure 2.5). It was also advertised in print media throughout the locality in the days before the event in order to attract participants from the neighborhood. Several posters and flyers (Figure 2.6) were placed in areas commonly frequented by local residents.

The location of the bookshop, San Lorenzo is known as a quarter inhabited mainly by university students and with a rich cultural and night life so it seemed a natural choice for the case study. The event itself started at 10.00am and potential participants were met by members of the EveryAware team as they entered the shop, and were instructed on how to download the WideNoise app and how to use the app. Additionally, they were encouraged to register their user details, and then dispatched to various different areas in the location in order to maximise noise measurement coverage.

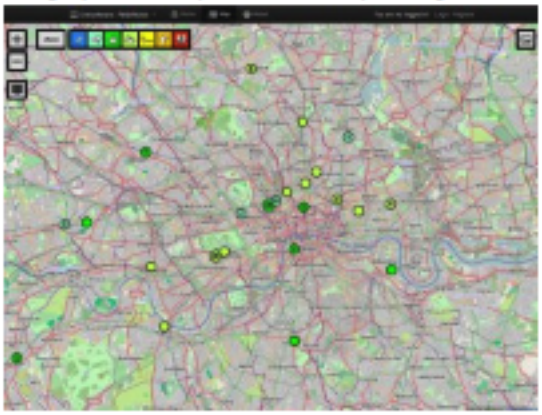
2.1.3 Beta Test 2 – Recruiting Participants for Air Quality Case Studies

Figure 2.2: Mapping for Change Blog Post, including WideNoise app

Mapping4Change @ #LCCS2

2nd London Citizen Cyberscience Summit

Mapping for Change, took part in the 2nd Citizen Cyberscience Summit held at the Royal Geographic Society and University College London last week on 16th, 17th and 18th February.



In a Summit that gathered leading specialists of citizen science, the Chief Executive of Mapping for Change, Louise Francis, gave a talk about **Community air pollution monitoring in London**. She explained how this research project, carried out at University College London (UCL) and part of **EVERYAWARE**, has involved citizen scientists across London in monitoring nitrogen dioxide levels to assess local air quality. Local residents were responsible for gathering the information whilst Mapping for Change and UCL were responsible for the analysis that was finally compiled into several maps. These have now been incorporated into the Air Quality Community Map, to enable other communities to collect and visualise their data.

During the event, Mapping for Change also engaged with participants to download the newly launched Widenoise phone app, and were asked to take noise readings throughout of the three days summit. Widenoise forms one of the sensors being developed that will enable communities to collect and visualise a range of environmental data.

Mapping for Change is also a collaborator of UCL's newly launched interdisciplinary **Extreme Citizen Science (ExCiteS)** research group, whose aim is to develop 'extreme' citizen science tools and methodologies to be used by any community, regardless of their scientific knowledge or level of literacy. The idea is that the tools that will be used to collect and understand data can be shared using Mapping for Change expertise and platforms. The result is expected to help local communities by empowering local groups and support actions connected to environmental change or any other issues that those communities

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Figure 2.3: China Dialogue Report of the Summit

Figure 2.4: Tweet for “Se Giochi Fai Scienza”

Figure 2.5: Website for the EveryAware Rome Activity

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Figure 2.6: Flyer for the EveryAware Rome Activity

Figure 2.7: The “Libreria Assaggi” bookshop, taken during the event

Full execution of the second Beta Test, which focuses on Air Quality, was dependent on the availability of the EveryAware Air Quality sensing box, scheduled to be developed over the first half of the project. However, given that recruitment and engagement of participants is not achievable overnight, in the absence of the various components that were being developed to construct the EveryAware platform it was decided to initiate some low-tech air quality sensing activities in the early stages of the project, and to recruit participants for these sensing activities. This was deemed a valuable exercise for several reasons. Firstly, one of the research questions put forward as part of the project seeks to explore the motivations of people that participate in community-based activities such as the sensing processes underpinning work within this project. Another question under investigation is whether access to appropriate personalized sensor information leads to changes in behaviour. Thus the aims of this activity were to obtain a better understanding of the processes that facilitate long-term engagement, including whether engagement making use of low-tech tools would generate a long-lasting interest that would transition to the higher-tech sensor box, as well as to gain a better understanding of the level of commitment that participants show, and whether they will change habitual behaviour to participate.

With these in mind participants concerned about harmful levels of air pollution, were recruited through the use of use of Twitter (Figure 2.8 shows the initial tweet, which was made a ‘top tweet’ and Figure 2.9 shows a sample of the responses received) and local community festivals and seminars, including a local climate conference, the London Assembly (London-wide government) air pollution and health seminar and the Gillespie community festival.

Figure 2.8: Initial Tweet to recruit Participants for Air Quality Studies

Details of the commitment required from participants were provided via the Mapping for Change

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Figure 2.9: Responses to the Recruitment Tweet

website (Mapping for Change is EveryAware's Community Engaegment partner, (Figure 2.10). Benefits to the participants included a way to measure air quality using low-tech methods that can be replicated across the country and can engage all sectors of the community to participate and the results provided groups with reliable localized data which could be used to lobby local government, raise awareness, generate a better understanding of the issues and which they can compare with other relevant datasets.

Two air quality mapping approaches were tried. Firstly, Nitrogen Dioxide (NO_2) was measured via diffusion tubes, as show in Figures 2.11 and 2.12. These tubes were attached by participants to locations at a given height above the ground (Figure 2.12) and left in place for 4 weeks. Nitrogen dioxide (NO_2) was selected as the focus primarily because of the affordability of the monitoring equipment. Additionally, levels of NO_2 are largely generated by vehicle exhausts in London, and are a strong indicator of the presence of other air pollutants created by vehicle emissions. In each location, a series of diffusion tubes, used to measure NO_2 levels, were set out across the area. The areas were divided up into grid squares to ensure there was sufficient coverage (Figure 2.13). After a period of between three-to-four weeks the diffusion tubes were collected and analyzed and the results mapped for each location.

Secondly, metal particles were measured via wipe samples, as shown in Figures 2.14 and 2.15. In this case, the wipes were used to wipe a fixed surface area (defined by a specific frame) and the results sent off to a laboratory for analysis. Figure 2.16 shows the form that participants were required to complete for each sample taken.

Following completion of the tests, the results obtained were fed back to the communities through a series of public meetings.

2.1.4 Beta Test 2b – Recruiting Participants for Antwerp Air Quality Case Study with the EveryAware Sensor Box

Following on from initial recruitment activities in London described above, a second phase of recruitment was carried out in Antwerp to recruit participants to work with the EveryAware SensorBox and Air Quality app (AQA). The pilot case study in Antwerp has the objective to test the SensorBox and the AQA "in real-life", to collect the necessary data for calibrating the SensorBox and to test the ability to recruit volunteers and to assess their willingness to participate. Different calibration strategies were tested and based on the results of this pilot case study, guidelines for future case studies will be developed.

For the pilot case study in Antwerp people were recruited via the networks of VITO (EveryAware partners, Viaamse Instelling voor Technologisch Onderzoek). A flyer was developed (Figure 2.17) and distributed through the internal VITO mailing list and to personal contacts of VITO team members with the request to pass it further on using mail, twitter or facebook. Further, the advertisement was published on EMIS, an information system on energy and environment of the local government.

On the flyer and in the advertisement, motivated people were asked to volunteer for collaboration in the case study if they were interested in the quality of the environment they are living in and if they have time available to monitor their environment. Individual persons were targeted, and two different ways to collaborate were proposed. Firstly, they could volunteer to carry out dedicated measurements during at least three hours on three days, or secondly, they could carry the SensorBox on their daily routines if they work outside for a large part of the day (e. g. for work, commuting, etc).

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Figure 2.10: Commitment from Participants for Air Quality Monitoring

Community Air Quality Monitoring

Are you concerned about the air quality in your neighbourhood? Are you interested in learning about the situation by collecting data where you live, work or your children go to school and seeing the results of the analysis? If so then get involved and join the citizen scientists!

Many people are rightly worried about London's air. But air pollution can be hard to measure, and most air quality monitoring carried out by local councils relies on measurements from a few fixed measuring points. These often fail to reflect the ways in which air quality varies across small distances. There are many factors that affect our air, which makes the need for better measurement even more important.

A new research project based at University College London (UCL) is giving communities the resources and support to monitor local environmental conditions. The data you gather will help create a clearer picture of air quality at the very local level. This will inform us all and help encourage the Mayor and local councils take effective measures to improve our environment.

How does this work?

Mapping for Change is a social enterprise set up by University College London, and the charity London 21. We can help communities to collect information to build an accurate picture of **local air quality** where you live. You collect the information – we do the technical analysis.

Our work looks at four issues. We'll measure levels of two chemicals in the air: nitrogen dioxide (NO_2) and ozone (O_3). We'll also assess particles in the air ('particulate matter') and your personal perceptions of how it feels.

What do you need to commit to?

To assess NO_2 levels all that's required of you is:

1. 1 hour in week one to position the diffusion tube in a suitable location
2. 1 hour in the fourth week to collect the diffusion tube
3. ½ an hour at the beginning and the end to collect the equipment and drop it off to your Local Co-ordinator

You don't need to be any kind of expert. But we do need your voluntary help. We'll give you everything you need and will analyse the information. When that's been done we will present the information on a local map to everyone involved, and the wider community, in an open meeting. We will give you maps of the data for future use and dissemination.

To make this work we need your help (many hands make light work!). We'd like to find at least **six 'citizen scientists'** - community volunteers in your area (anywhere in **Southeast England**), who can put in a bit of time over 4 weeks, and one person to agree to act as Local Co-ordinator.

If you would like to monitor any other pollutants such as ozone get in touch with us and we can give you the details of what's required.

Can I get involved?

Yes! To get involved or find out more about the methods that will be used visit our website at: www.mappingforchange.org.uk

You also can contact us by phone (call 020 7679 2296) or email us: l.francis@mappingforchange.org.uk

Figure 2.11: A Diffusion Tube

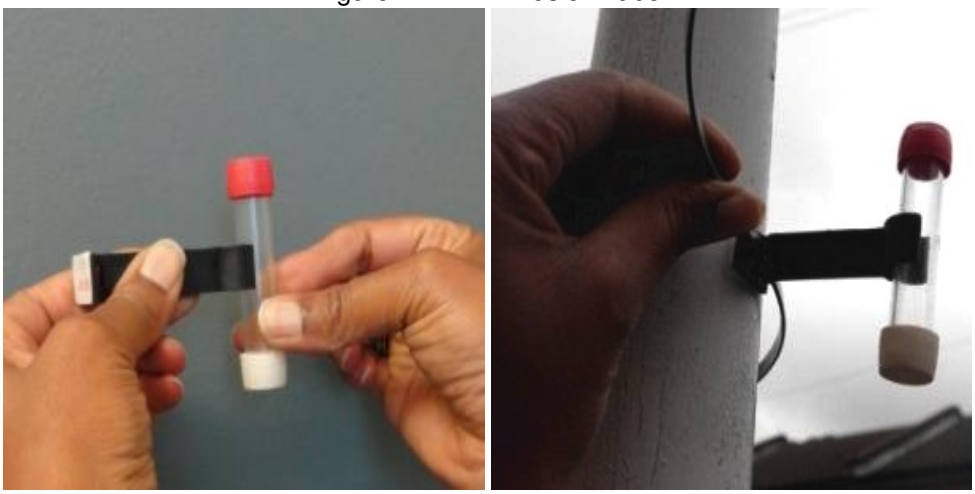

Figure 2.12: Affixing a Diffusion Tube onto a Lamp post.

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Figure 2.13: Grid Map for Diffusion Tubes

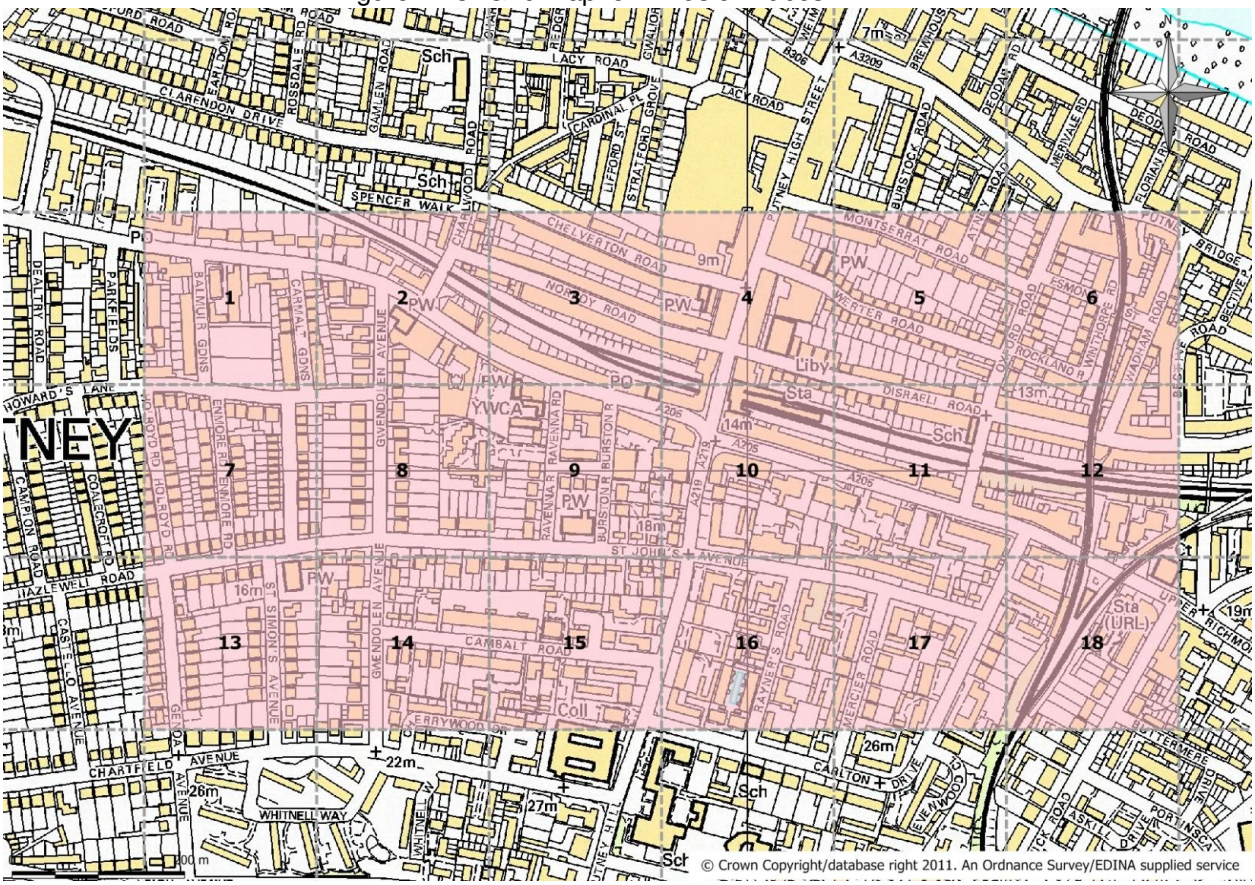

Figure 2.14: Wipe Samples

Figure 2.15: Using the Wipe Samples

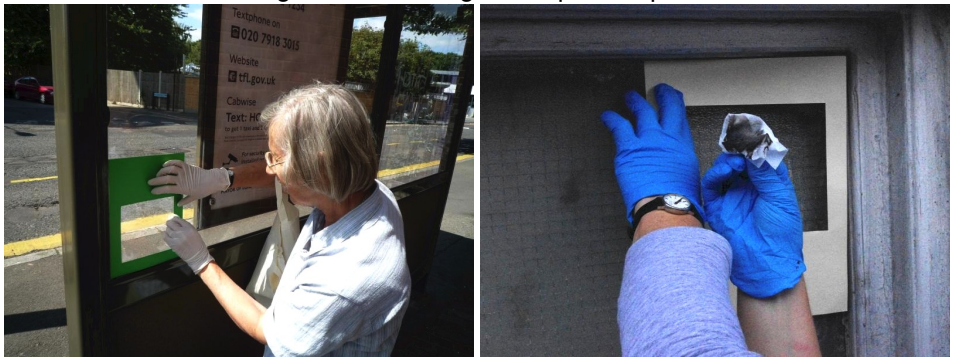

Figure 2.16: Form Required for Wipe Sampling

Surveyor Name:

Contact Details:

Details	Tubes Put Out	Tubes Taken In
Date		
Time (use 24 hour clock)		
Name of Road		
Location Description (e.g. residential street, park, high street).		
Site Characteristics (e.g. building/road works, traffic diversion)		
Tube Condition (e.g. tube found on the ground, dirt, insect or liquid inside tube).		

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Figure 2.17: Antwerp Beta Test Recruitment Flyer

2.2 Analyzing the Data

For the analysis of data in EveryAware, a mixed methods approach has been used. Given the main aim of the studies – testing the EveryAware platform integration and validating a number of participant engagement techniques – a key approach to investigating recruitment and participation for the Beta Case Studies is quantitative. The reader is also referred to [UCL, 2012] and [VITO, 2012] for information on the usability analysis conducted on the WideNoise app and the potential interpolation methods appropriate to noise and air quality datasets. These elements form an important component of the Beta Case Studies.

The structure of the EveryAware database (described in [LUH, 2012]), which collected the WideNoise data permits a number of targeted as well as exploratory queries to be carried out. The database allowed the separation of participants into the beta tests by date, time or spatial location. Queries such as average user mapping distance and user usage longevity can be carried out. For example, to measure the impact of the first Beta Case Study (via the Cyber Science Summit), the overall number of points gathered during and in the weeks following the Summit were measured – as participants originated from around the world, it was not possible to geographically confine the analysis in this case.

Given that each device has a unique identifier in the database, it is also possible to track usage for individual users across time. Who has contributed the most points, and where? Was this in the context of a specific event or campaign or just out of general interest? Of the users who contributed over a certain number of points, were they most active at the beginning of their contribution period, or was activity consistent across the weeks and months of participation? Did the device type (Android, iOS) make a difference when examining users' contributions?

Additionally, in the WideNoise system, a number of users are registered and thus their specific noise monitoring can be examined – do they make use of the sliders and tags to provide subjective information? At what time of day is data captured? One of the assumptions of the project were that the sliders and tags options in the WideNoise application would provide context on the participants activities so a number of queries were made on this relationship.

Although data from the second case study is not uploaded to the EveryAware database, as the low-tech approach was chosen, the data has been mapped manually in a spatial database. Therefore, it is also possible to analyze this data using similar methods of spatial analysis to answer questions such as which are the most polluted points or streets in the areas under investigation. In this case, given the direct contact with participants, it was also possible to undertake some qualitative analysis of the results obtained – and in particular monitor the impact that the exercise had on the behaviour of the local community groups – were they able to use the data captured to further their interest in local air quality?

2.3 Results of the Beta Case Studies

This section presents some initial results from the two Beta Case Studies, and draws some preliminary conclusions as to the effectiveness of the various recruitment and engagement processes used.

2.3.1 Results – Beta Test 1 – Noise, London

A total of around 900 tweets were generated regarding the Cyber Science summit, along with more than 150 mentions online (in articles and blogs). Although many of these did not mention EveryAware or WideNoise specifically, on the first day of the Citizen Cyber Science summit, 133

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readings were captured in the system by the delegates, on the second, 157 recordings were made, and on the final day a further 165 readings were created (Figure 2.18 shows these points).

Figure 2.18: WideNoise Points Captured During the Summit

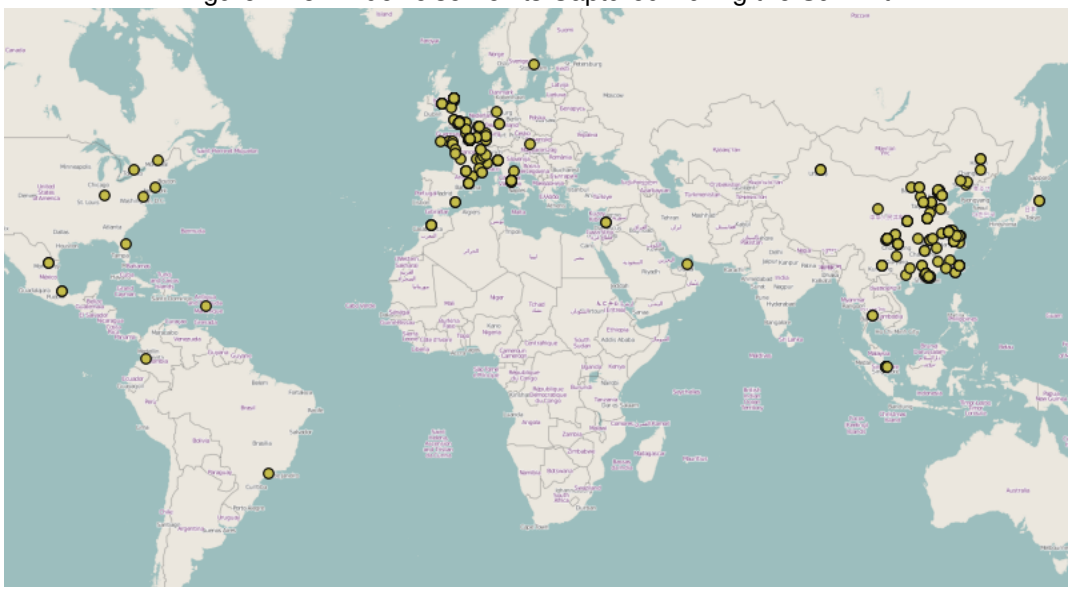


Figure 2.19: Bloomsbury Points Captured During the Summit

Over the first week including the three days of the summit, a total of 1013 readings were captured, compared to 315 readings in the week prior to the summit. The average of decibel level for these readings was 60.8 dB, and geographically the readings were spread over 42 countries during the first week, compared to points from 29 countries in the week before and 50 countries in the following week. More specifically, 33 points were captured around the Bloomsbury area of London, where UCL is based (Figure 2.19). Additionally, 565 points were captured in China.

In general, the response from the Summit activity served to validate the integration of the EveryAware platform. However, the response to the various recruitment techniques employed can be said to be mixed. 635 different devices contributed points during the week of the summit, but 374 of these were in China and the response in the UK, where the summit itself was held was only 166 points contributed by 55 different devices. Although a significant jump in data points captured was observed from the previous week, many users contributed only 1 point (around 300 users) and only 11 different devices were registered to the system.

Although speculative, it may be possible to identify an explanation for the relatively large number of points contributed from China. This could perhaps be due to the article about the summit was included in China Dialogue (Figure 2.3). However, as only one of the 374 users from China registered to the system, it is not possible to identify them and determine their motivations for downloading the app. Additionally, give the population of China, the numbers may also be due to random downloads.

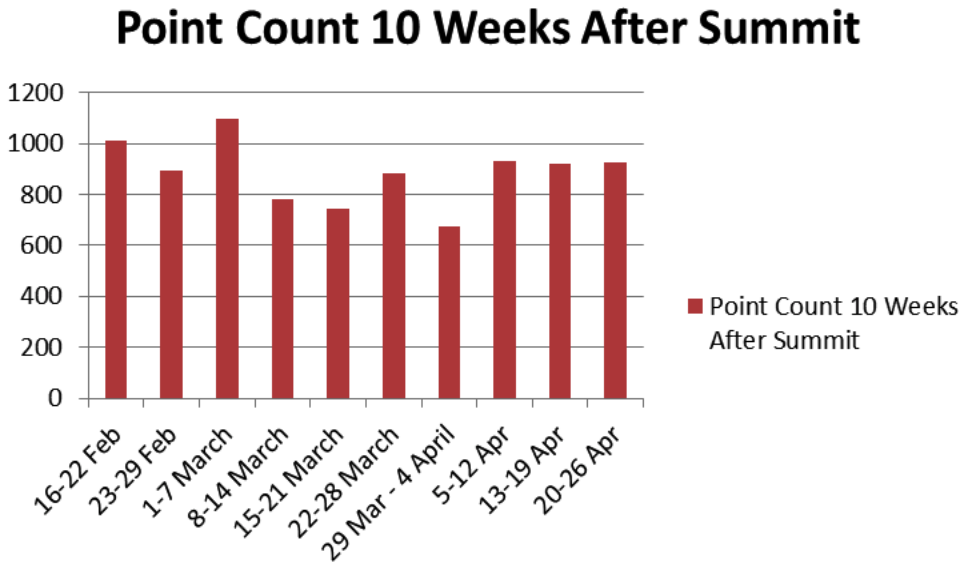
Importantly, although the overall response by the delegates to the application was enthusiastic there were some significant usability issues which were communicated back to the technical team developing the WideNoise application. These usability issues include issues with the sliders and tagging and are discussed further in [UCL, 2012], and may have significantly impacted the success of the Cyber Science summit recruitment campaigns.

Given that one of the issues faced with WideNoise related to the difficulties with the registration process, it is not possible to quantify the longer-term impact of the summit specifically as no user contact details are available for a follow-up questionnaire.

Examining Results Over a Longer Term

Figure 2.20 below shows the overall number of points captured on a weekly basis in the 10 weeks following the summit. As can be seen, the number of points remains fairly consistent. Examining the results in more detail, Figure 2.21 show the numbers of points captured on a daily basis before, during and after the summit. As can be seen, the number of points increased in the days before the summit (the summit itself started on a Thursday), and then remained relatively constant in the weeks following, with peak readings dominating in the second week after the summit.

Figure 2.20: Total Points Captured During the 10 Weeks After the Summit



Examining the location where the data was captured also provides some insight into the uptake of the WideNoise app. Table 2.1 shows these locations, and illustrates the range of countries where the app was used. Again, the post-summit downloads cannot perhaps be directly attributed to the summit, but could also be attributed to random app downloads by users with no connection to the project at all. However, in the week prior to the summit, Italy dominated the rankings (this is the location of one of the project teams and also of the app developers). Points captured in the United Kingdom increased significantly during the week of the summit itself, dropping again in the following week – perhaps due to the fact that the summit had a very international audience.

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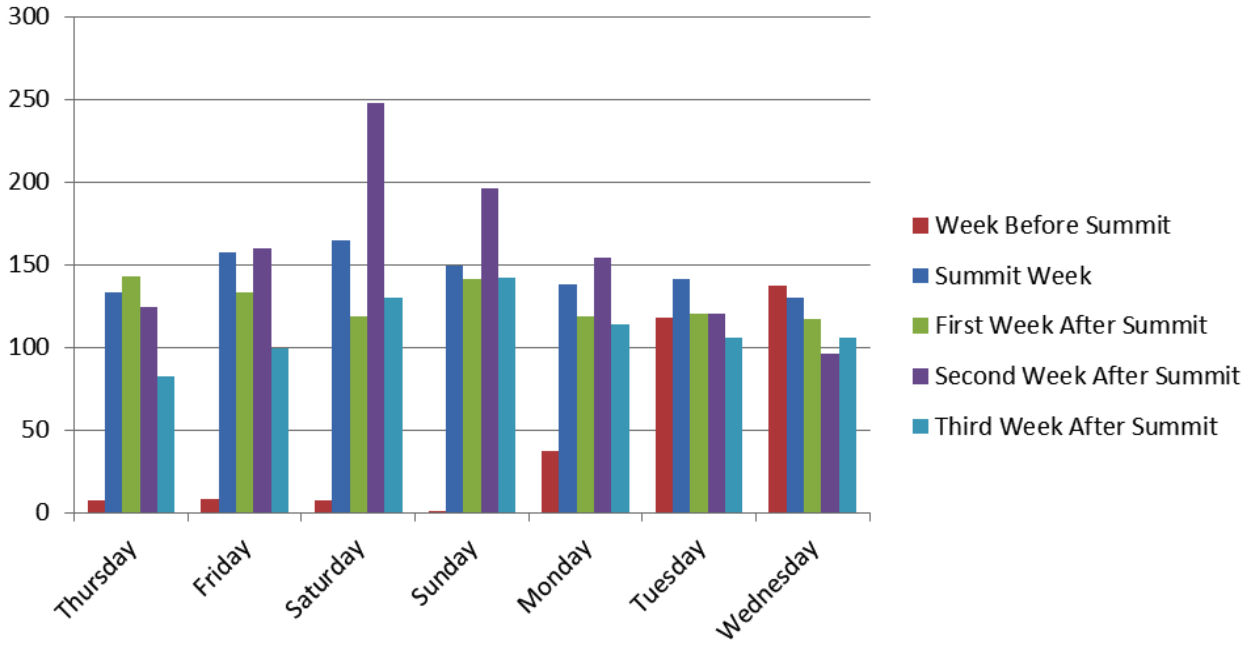
Figure 2.21: Total Points Captured on a Daily Basis Before, During and After the Summit



2.3.2 Results – Beta Test 1b – Noise, Rome

In the Rome case, 784 points in total were captured on the 9th June 2012. Of these, 688 were captured in the Rome area, by a total of 18 distinct users (devices) including 15 members of the general public. Great differences between the number of points captured by different users can be observed (Figure 2.22), with high numbers (102, 115, 295) captured by some members (including members of the project team, who set out to provide a systematic noise map of the area) versus 12 users who captured under 10 points. Figure 2.23 shows a map of the results, with high point density around the location of the event (shown in red).

Figure 2.22: Points Captured by Individual Users during the Rome Activity

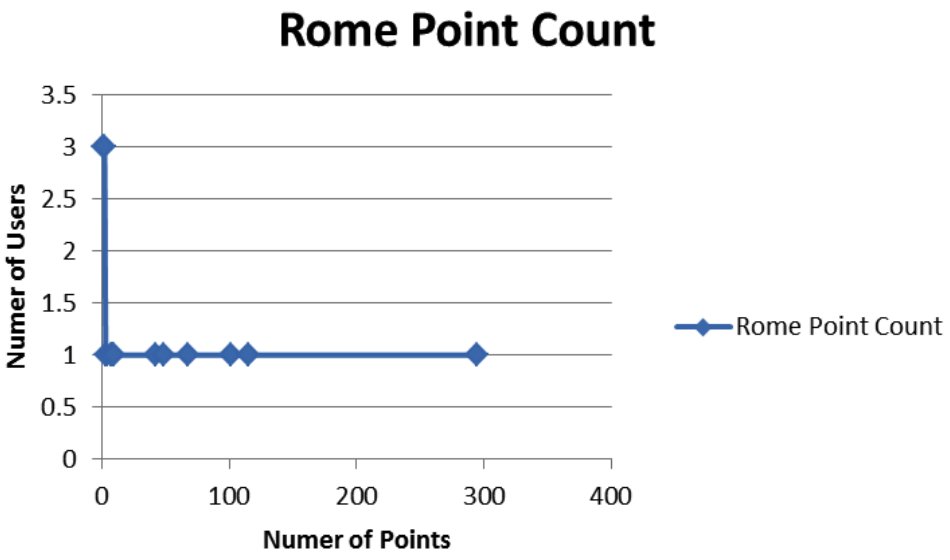
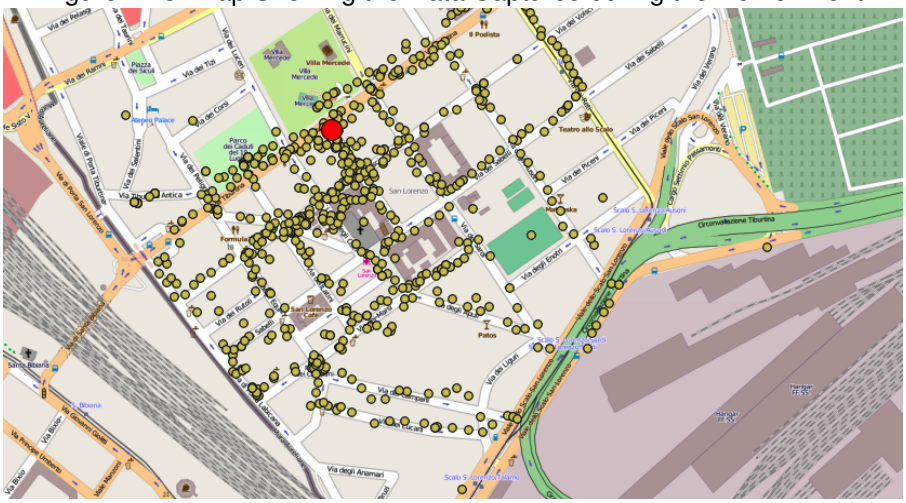


Table 2.1: WideNoise Locations Before, During and After the Summit

Week Prior to the Summit		Week of the Summit		Week Following the Summit	
107	Italy	565	China	591	China
64	China	166	France	169	France
59	France	166	United King-dom	39	Italy
35	Germany	46	Italy	38	Russia
21	United King-dom	39	Taiwan	31	Taiwan
14	United States	28	United States	27	United Kingdom
10	Austria	27	Spain	25	United States
9	Hungary	20	Germany	20	Belgium
9	Taiwan	18	Indonesia	19	Germany
6	Canada	18	Malaysia	16	Netherlands

Figure 2.23: Map Showing the Data Captured during the Rome Event



As with the other pilot Case Studies, in the Rome event too few readings were gathered over too short a space of time to be able to state anything with significant numerical reliability. However, some interesting observations can be made. Firstly, even with a relatively small number of measurements, the main streets in the area can be seen clearly and show louder readings (Figure 2.24. Secondly, a great amount of variability in noise level can be seen even over very short distances. Examining the subjective data, it can be noted that all the sliders show similar correlation with the noise level: all the curves show a negative correlation for lower level of the sliders and a positive correlation for higher sliders values. In particular, the feeling slider (“calm vs hectic”) shows a very strong correlation at higher values of noise. This seems to suggest that stronger noises cause stronger reactions, even if the reaction is to feel calm, or alone. Further research is required to verify whether this is a significant result.

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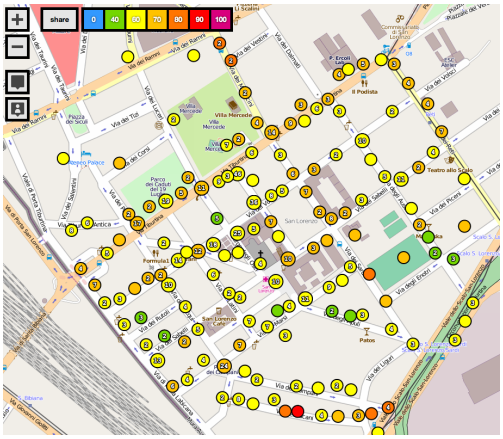


Figure 2.24: The noise map of the case study in San Lorenzo, Rome, with noise levels in decibels.

Table 2.2: Measurement Ranges for Low-Tech Air Quality Monitoring

NO2 Value	**Number of Points**
Below 40	44
Between 40 and 60	25
Between 60 and 80	18
Between 80 and 100	4
Above 100	13

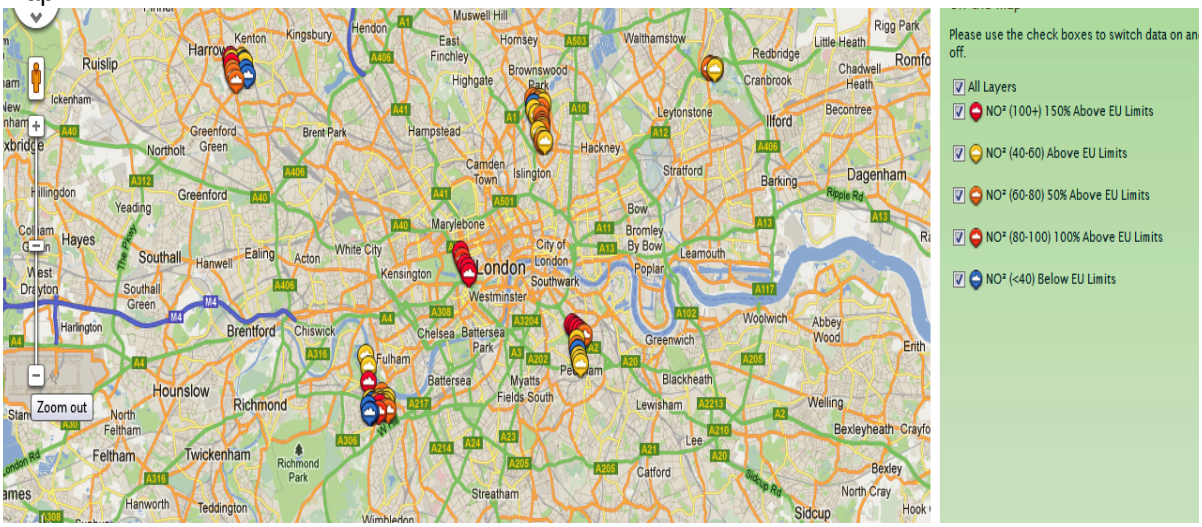
2.3.3 Results - Beta Test 2 – Air Quality, London

For the second Beta study, the recruitment process resulted in the identification of seven locations across London with interest in participating. Further interest was shown by an additional 9 groups who unfortunately could not be accommodated due to limited availability of the low-tech air quality monitoring devices and funds for processing the resulting data. Residents in Putney, South London, and Highbury in the north of the city took part in the study. A number of volunteers from Sustrans, a charity promoting sustainable transport, also participated, covering an additional five locations. An average of 15 participants per location were actively involved in the monitoring activities, either swiping wipes or monitoring diffusion tubes. An investment of around 10 hours' time for each participant was required. A total of 104 measurements were taken, falling into the ranges shown in Table 2.2 below.

Figure 2.25 shows the resulting points captured on the Mapping for Change Air Quality Community map – where they are accessible to the general public. Putney, with a total of 38 sites, had the most monitoring locations.

Examining individual results, a number of patterns can be noted. For example, the results from both Putney and Highbury indicated that levels along the main road network were up to 75% above EU limits for the period. They also highlighted several residential back-roads used as 'rat runs' (or short cuts takenby drivers to avoid main roads). Figure 2.26 and Figure 2.27 show these results in detail. The remaining five monitoring locations across London each comprised of one of London's Greenways (safe, quiet routes through parks, green spaces and lightly trafficked streets) with an adjacent busy road. The results showed significantly higher NO2 levels on the roads compared with the Greenways, despite their close proximity. Figures 2.28 and 2.29 show this in detail for Southwark and Brent.

Figure 2.25: Low Tech Air Quality Points Shown on the Mapping for Change Air Quality Community Map



2.4 Outcomes of the Beta Case Studies

2.4.1 Best Tests 1 and 1b – Recruiting Participants for Noise Monitoring

The increase in the number of points captured appear to indicate that the publicity given to the WideNoise app as part of the Cyber Science summit did result in increased quantities of noise data capture, and online articles in international press potentially impact the download and usage of the app. However, this was perhaps not as successful as could be hoped. Given a number of usability issues that were reported over the period (see [UCL, 2012]), it is difficult to determine whether this had significant impact on the results obtained. Usability of the tools is fundamental to ongoing success of the project – failure at any point in an interaction process will discourage people from using WideNoise. Similarly, the Rome activity had limited success in terms of engaging participants from the general public, although in this case members of the EveryAware team proved that it was possible to capture a very dense noise map using the WideNoise app.

Examining the data in more detail, it can be seen that in both cases, as with many other crowd-sourcing projects, the majority of users tried the app once and then disengaged from the task, capturing only one point. Registration of users –or the lack thereof – also proved to be an issue. This lack of registration, which could be caused by reported difficulties with the process, unfortunately means that it is not possible to gauge motivation for recruitment and engagement with WideNoise for this Beta Test. Additionally, it also could be said to indicate an overall lack of interest by the users in viewing their personalized data on the WideNoise online map.

In the weeks following on from the London Beta test, a fairly consistent number of points was captured, although again it was not possible to attribute this to the recruitment methods used during the Cyber Science Summit, due to lack of user registration. Therefore, although the Beta test could be said to meet its primary aim of validating (or otherwise) integration of the EveryAware tools and platform, and usability of the tools, it can also be said that relatively limited success was obtained on the participation and recruitment front.

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Figure 2.26: Nitrogen Dioxide Levels in Putney

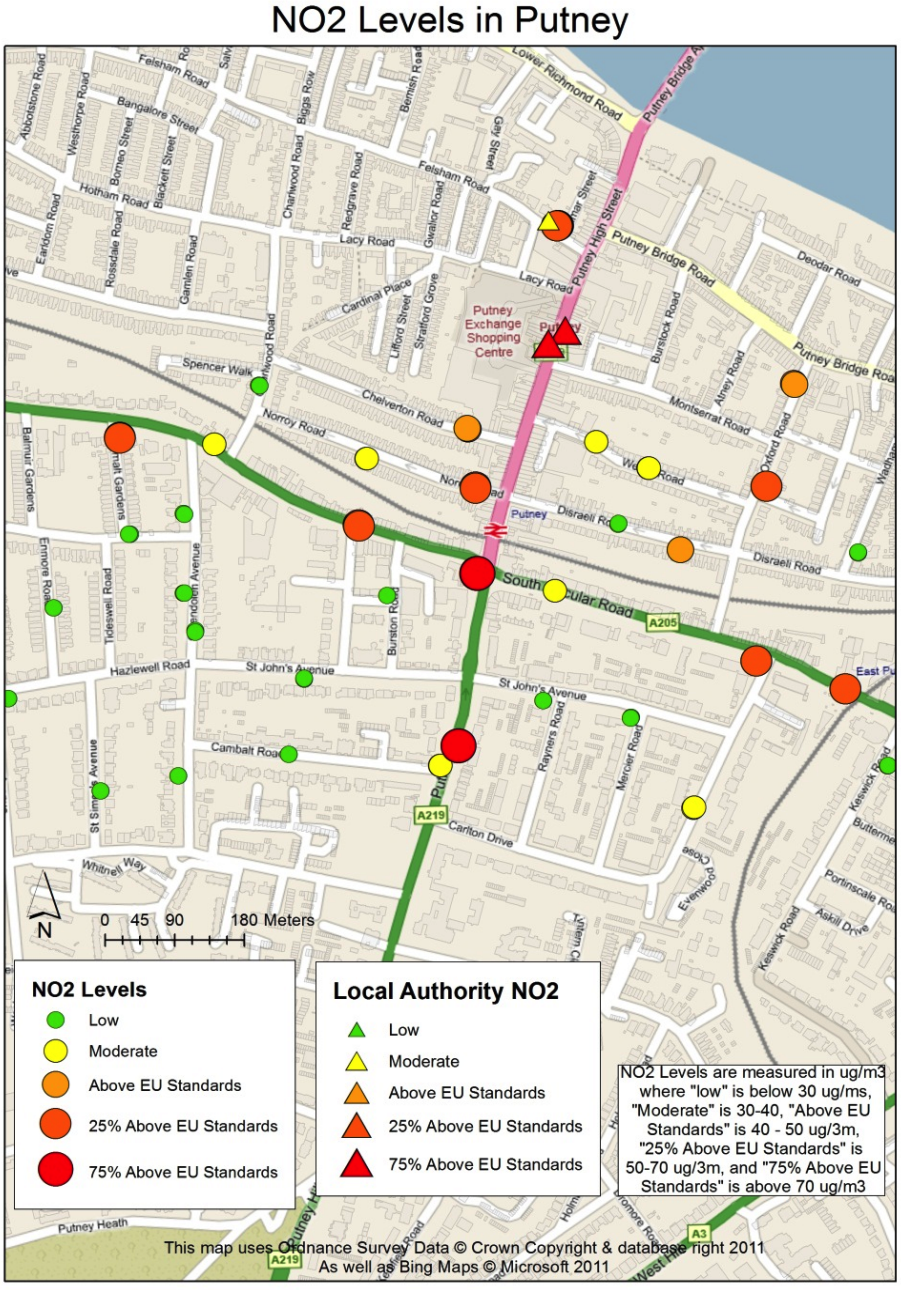

Figure 2.27: Nitrogen Dioxide Levels in Highbury

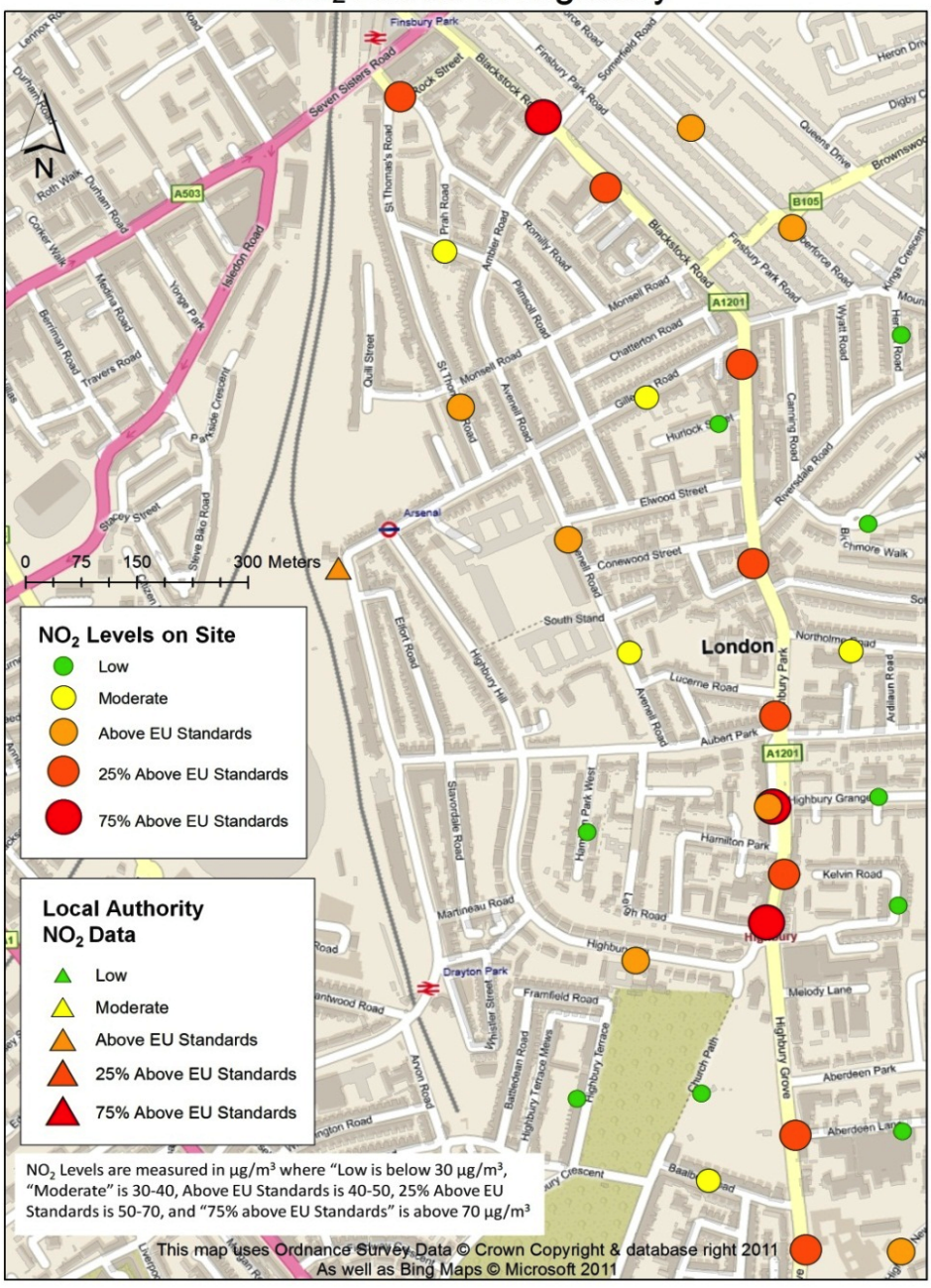

Figure 2.28: Nitrogen Dioxide Levels in Southwark

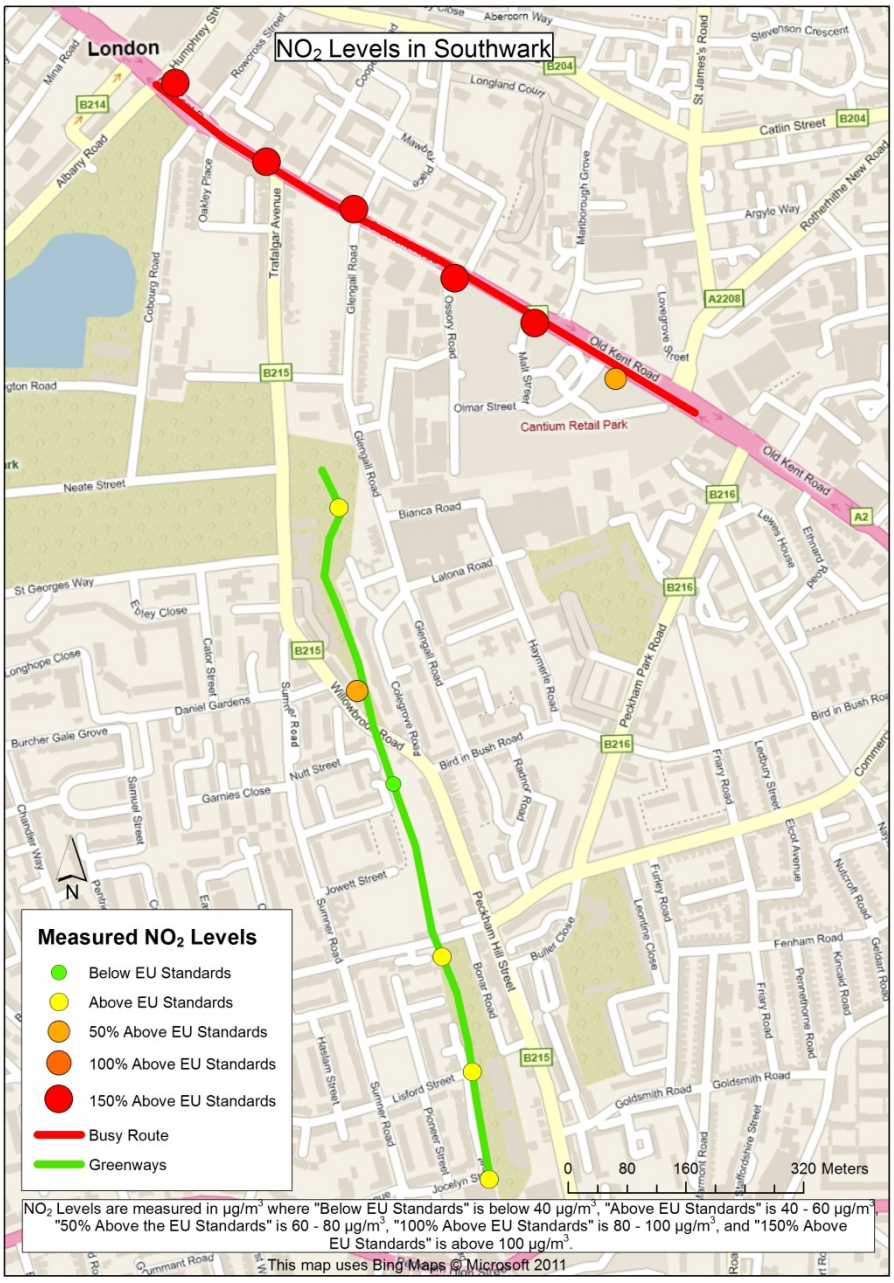

Figure 2.29: Nitrogen Dioxide Levels in Brent

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2.4.2 Best Test 2 and 2b – Recruiting Participants for Air Quality Monitoring

Low Technology Tests

In contrast with the first Beta tests, recruiting participants for the air quality monitoring tasks was generally very successful, with a total of nine additional groups showing interest but not being accommodated due to limited resources. In addition, participants (around 15 from each of the 7 selected sites) showed on-going commitment to the task during the four weeks required for monitoring activities. This demonstrates that there is widespread interest in Air Quality and low-tech tools provide a useful way to engage a large number of participants.

Looking at the differences between the recruitment processes for the two Beta tests, it could be suggested that a mixture of social media, flyers and posters, and on-going face to face engagement leads to a good level of commitment to a project, when compared to one-off activities such as the summit. Additionally the importance of recruiting participants having a specific interest in the topic under examination should not be underestimated.

Significantly, the closing activities of the air quality monitoring process showed the impact of the air quality campaign. These took the form of a number of public meetings, the first of which was held in Highbury and was attended by over forty local residents, the Green Party London Mayoral candidate, the Local Authority and CleanAirLondon Director, Simon Birkett. Jenny Jones, the Mayoral candidate, said that the results were terrifying, but that the turnout had brought her hope and that the issue was obviously important to local communities. A Public Protection Officer from the Local Authority who attended the meeting expressed her support for the study and highlighted the difficulties they have had in engaging the public. She welcomed any move to raise awareness at the local level. The community was shocked to learn that even if they live in quiet back streets, their children who walk in the local area, are subject to dangerously high levels of pollution. They came up with a list of measures which they could adopt to reduce exposure and production of harmful emissions. They also listed suggestions to be put forward to the Mayor and Local Authority (see Figure 2.30).

Equally importantly for the EveryAware project, the overall interest in air quality issues has been highlighted and contacts established which will facilitate recruitment for a potential large scale air quality case study in London. This activity will also permit investigation into longer term engagement and motivation issues - do the current participants still show interest even though there will be a time lag between activities?

A second consequence of the air quality activity was the allocation of additional funding to Sustrans, the environmental charity that was a partner in this task. In all, the funding for the London Greenways managed by Sustrans was doubled. (See Figures 2.31 and 2.32).

2.4.3 Comparing the Beta Test Outcomes

Comparing the two case studies, many similar participant engagement activities were trialled in both cases – particularly the use of online media and social media such as twitter. However, differing outcomes were observed, indicating that additional factors influence the recruitment and engagement process. Key differences can be identified when considering the various stages of a typical Case Study involving members of the public, as follows:

1. Stage 1 (Group Identification) and Stage 2 (Participant Recruitment) – in the case of the first Beta test, the ‘group’ in question was very broad in nature, and included any members of the public attending a specific summit or activity. No particular interest in the topic was required as a pre-requisite for participation, and additional participants could be ‘recruited’ without having any direct contact with members of the EveryAware team. For the second Beta test,

Figure 2.30: Suggestions to the Local Authority Captured During a Meeting in Highbury

a more traditional approach to recruitment was taken, involving face-to-face contact and participants having an interest in the specific topic at hand.

2. Stage 3 – Workshop. Again, the two case studies differ, in that for the first studies a specific noise-focused workshop was not held (although more general activities were held as part of the Cyber Science Summit and the Bookshop Activity). The second case study involved a series of topic-focused workshops where direct contact was made with various participants.

3. Stage 4 – Data collection. This stage was present in both cases, although in Case Study 2 it was time-constrained, which could perhaps be said to give more focus to the data collection task. In Beta Case 1, as no additional equipment or investment was required by the end user, there was no specific incentive to complete data collection to a reasonable level of coverage within a specific time period.

4. Stage 5 – Participant debrief and data evaluation. This task did not take place at all for the first Beta Case study, as the participants were very geographically dispersed. In contrast, the debriefing session and wider public meeting proved to have fundamental importance to the ongoing success of the air quality monitoring activities, offering the opportunity to engage directly with the relevant officials.

Given this comparison, a number of additional key factors could be said to influence the very different outcomes obtained. The findings the second beta study suggested that recruiting engaged participants, having a specific issue or interest local to their area, is perhaps a better way of fostering engagement and carrying out environmental monitoring than a more broad-spectrum process involving a geographically dispersed community without a specific interest in the topic at hand. Additionally, the air quality campaign also showed that adapting and incorporating design suggestions from the participant groups is beneficial for creating successful participation projects. The material related to the second Beta study shows that producing printed material with relevant links and information was crucial for communicating the project to the target audience. Having a geographically focused campaign permits additional analysis of the resulting data, with perhaps a greater focus on behaviour change. This is particularly important for noise monitoring, where

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Figure 2.31: Question and Answer, to the Mayor of London, regarding Greenways Funding

Mayor answers to London

Air Quality on London Greenways

Question number 0263/2012

Meeting date 25/01/2012

Question by
Mike Tuffrey

New research findings from Sustrans suggest that levels of Nitrogen Dioxide (NO2) on London Greenways (safe, quiet routes through parks, green spaces and lightly trafficked streets) are up to 60% lower than on adjacent busy roads. Given this dramatically improved air quality, and in view of the public health benefits, will you increase the dedicated annual funding stream for Londons Greenways to its previous level of £4m (2009/10) and establish a strategic network across London?

Answer by Boris Johnson (1st Term)
I am pleased to recognise and promote the myriad benefits of cycling and have long held that Greenways provide a positive way for pedestrians and cyclists of all ages and abilities to make the most of Londons wealth of parks, open spaces and waterways. Transport for London is soon to publish the annual Greenways monitoring report that will complement the research done by Sustrans to which you refer.

TfL is already supporting the development of a strategic London Greenways network through its Greenways programme which, together with delivery partners such as Sustrans, the Royal Parks and British Waterways, opens up more of the Capitals green and open spaces year-on-year. To further support this work, I plan to increase the budget for the Greenways programme from £0.8m to £1.9m for the next two years. Officers at TfL are now discussing with their delivery partners how to use this funding to best effect.

Figure 2.32: Report Showing that Funding for the London Greenways Has Doubled

Following a meeting with the Deputy Mayor for transport last year, we developed a business proposal of quick wins and major schemes which we knew were 'ready to go' to show just how much extra demand there was for progress. We then commissioned a study to look at the air quality benefits of London Greenways which showed overwhelmingly lower levels of air pollution on the network when compared with busy main roads.

It's a real pleasure to hear that the Mayor has more than doubled the ring-fenced funding for London Greenways for 2012/12 and 2013/14 to £1.9m per year. This is in addition to the funding which boroughs allocate to greenway development in their area.

participants often don't register and may not have any direct contact with the EveryAware team. Finally, the usability of the tools forming part of the citizen science activity plays an important factor in any recruitment process – in the case of WideNoise, significant effort is required to capture noise readings, and active user involvement is required each time. This is contrasted with the diffusion tubes, which require only intermittent monitoring.

In summary, to date, the environmental knowledge produced as a result of the EveryAware project has been used to gain media coverage, hold public meetings, lobby Mayoral candidates, hold talks with Transport for London, engage London Assembly Members and generally widen awareness of the air quality issue. Although at the moment this has been limited to air quality, it is expected that similar results can be obtained through noise monitoring with targeted groups having a specific interest in the topic, as will be seen in the next section. Engaging communities in such citizen science activities raises a greater understanding of the related issues. In addition, it encourages participation in civic and democratic processes, giving residents from the most socially deprived and disempowered parts the confidence to call for change.

These initial findings lead to the selection of a focused, interest group for the first large scale case study. A local community engagement officer was employed, and focus was given to producing posters and leaflets and manuals for the large-scale case study. This is described in more detail in Section 3.

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Chapter 3

Ongoing Large Scale Case Study - Heathrow Airport

As outlined in the EveryAware proposal, the aim of the large-scale case studies is to recruit a large number of users and to investigate their motivations and any resulting changes in behaviour that result from taking part in environmental monitoring. A particular focus is to compare multiple recruitment methods for engaging participants in environmental monitoring[1].

In order to further the investigation into the importance of working with a community facing a specific issue versus one consisting of general users downloading the WideNoise app, for the large-scale case study it was decided to focus on a particular context where an issue-based community might be interested in noise mapping in their local environment. Heathrow airport, in London, was chosen as this context since it is the largest European airport and has been featured in the news due to a planned addition of a third airport runway and the consequent impacts on the noise experienced by the surrounding communities. This expansion is politically controversial with many local residents and environmentalists being opposed to the expansion due to noise as well as wider ecological impacts. For these reasons, the project team wished to validate whether residents would be motivated to take part in a large-scale noise mapping. The project team also had previous contacts with HACAN (Heathrow Association for the Control of Aircraft Noise) an issue-based pressure group focused around noise and the Heathrow airport extension. HACAN is a campaign organization *On behalf of those who suffer because of aircraft flight paths* [2].

The geographical focus of this case study means that it is possible to identify a number of population centers under the flight path as locations for workshops similar to those carried out as part of the second Beta test above. The first part of the large scale case study was carried out in Isleworth which is under the Heathrow flight path. The Isleworth project lasted for four weeks and involved three workshops: a public launch, a discussion workshop as well a final results presentation workshop.

3.1 Engaging Participants for the Large-Scale Case Study – Heathrow (Isleworth)

[1] It is important to note that the start of this case study anticipates the dates set out in EveryAware Annex 1, due to interest shown by the participating community group. The recruitment methods employed, and results described below, thus represent interim results of the case study as a whole.

[2] http://www.hacan.org.uk/about_us/

3.1.1 Overview of Recruitment Methods

Given that one of the aims of the research was to compare different methods of recruiting participants, it was decided to address people via a community campaign in association with HACAN and compare the results with those obtained via an advertising campaign. This would enable a comparison between the impact of an in-depth collaboration with a pressure group using their contacts, versus a more hands-off crowd-sourced advertising approach, as well as comparison with the previous methods using social media or a targeted event, as employed in the Beta Case Studies

The HACAN organization was selected as a key target for these efforts, as it has a large numbers of registered volunteers around Heathrow and it was hoped that collaborating with HACAN would encourage a large proportion of their thousands of members to become involved in noise monitoring, and hence provide detailed coverage. In addition HACAN have a strong agenda favoring the development of new ways of measuring noise as can be seen in this quote:

> "The way UK governments have traditionally measured noise no longer tallies with reality...We are calling on the Government to ditch this outdated way of measuring aircraft noise." *John Stewart, Chair of HACAN*

Importantly, in order to enable the large-scale case study to compare specific recruitment methods not initially envisaged in the EveryAware proposal, the decision was taken to apply for additional funding outside of the EU project budget. The UCL project team won an application for an internal UCL Inclusion Award with a budget of £14,653, which permitted a much wider range of techniques to be trialled that originally envisaged. This included both advertising and the recruitment of a dedicated community engagement officer.

3.1.2 Dedicated Community Engagement Officer

The most important consequence of this extra funding was that the opportunity to hire a temporary community officer, to work on the EveryAware project for the duration of the large-scale case study. The community officer was a member of the HACAN group and selected by John Stewart the chair of the organization.

> "Their role will be to work with the EveryAware team to enable them to reach a larger amount of people for a longer period of time and create qualitatively better engagement with the communities. We intend to pioneer a highly visible and highly localized outreach program using advertising billboards and on buses around the Heathrow flight path. The specific insights of the Community Officer will be crucial in designing the correct way to address the local people with the concept of citizen environmental monitoring. Having the Community Officer on the project will also allow two large scale participatory workshops to be organized in the local area, which will enable face-to-face collaboration between the project team and the local community." *Inclusion Award Application*

Importantly, unlike the UCL team, the engagement officer is a member of the community in question, has regular contact with other members and resides in the given location. This approach may help bridge the gap that could be perceived between 'outsiders' from UCL and members of the local community.

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3.1.3 The Advertising Campaign

The Inclusion Award also allowed the hiring of the Hype[3] advertising company to design a mixed media advertising campaign using different channels of print, public display, online and hand distribution. The advertising campaign ran for the duration of the Heathrow project which was four weeks. Using a budget of £5000 paid for by the inclusion award, the budget was split into four different methods of addressing people.

1. An advertising van (advertising banner on the side), see Figure 3.1
2. Website banner advert, see Figure 3.2.
3. Print advert in a local newspaper
4. A leaflet, handed out at local population centers and train stations

Figure 3.1: Photograph of the advertising van promoting WideNoise

Each one of the advertising channels was assigned a unique website URL which was included in the graphical design of the advert. This allowed Google Analytics to be installed on the landing page websites, to collect the number of visitors via the different channels. Each landing page was identical with a link to the android and iOS WideNoise applications. This means of separating the traffic meant that it is possible to track the amount click throughs to these landing pages but not the actual number of downloads of the WideNoise application. The metrics collected allow us to compare the different advertising channels as well as provide a sense of the amount of user engagement using advertising.

3.1.4 The Local Community Campaign

In consultation with HACAN it was concluded that a mix of methods would be most appropriate to launch the local community campaign. This meant that campaign includes TV news, local newspapers, local radio, hand-distributed flyers, posters in shop windows, the HACAN mailing list, local Residents Associations as well as twitter and Facebook.

[3] http://hype.co.uk/

Figure 3.2: Screenshot of the WideNoise banner advert on the Chiswickw4.com website

In order to promote the launch of the project, posters, flyers and a manual (Figure 3.5) were designed by the UCL project team. During the process of designing the poster it quickly became apparent how important it was to create a strong identity for the issue based campaign. It was decided to adopt the name 'Isleworth Noise Map' for the campaign and create a graphical design style would represent the oppressive impact of the noise in the local area, which was communicated by the lines radiating from the plane (Figure 3.3).

Importantly, this graphical style and mode of address was developed in association with the Project Officer from HACAN. It was felt that this positioned the campaign not as a dispassionate research project but that the project team was on 'their side', in this attempt to monitor the plane noise, and that this engaged rather than a dispassionate mode of address would perhaps motivate local participants and increase the amount of participation. To enhance the feeling of creating a local project, the EveryAware map of the world was zoomed onto the target area of Isleworth and a tinyURL[4] created for a portion of this global map. This had the effect of conceptually packaging the EveryAware map into a locally framed project.

The campaign itself launched on the 19th June 2012 with a public launch workshop at the Isleworth Public Hall. On the same day BBC news carried out an interview with the UCL project team, the head of HACAN John Stewart, as well as a local resident, who discussed her experience of plane noise. The interviews were shown on television and was temporarily available on the BBC website (Figure 3.4).

3.1.5 Communicating Information about the Tool

A 4-page manual was designed by the UCL project team, which explained how to download and use the WideNoise application to create sound readings (Figure 3.5). The only protocol guidance provided was to ask users to take their readings outdoors. This was felt to be important by the UCL team to improve GPS positioning as well as setting a common standard that would enable the data gathered and to be interpolated, to produce the final Noise Map, whilst at the same time allowing participants greater freedom in terms of when and where measurements were taken, perhaps

[4] http://tinyurl.com/isleworthnoisemap

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Figure 3.3: Poster distributed in the Isleworth target area

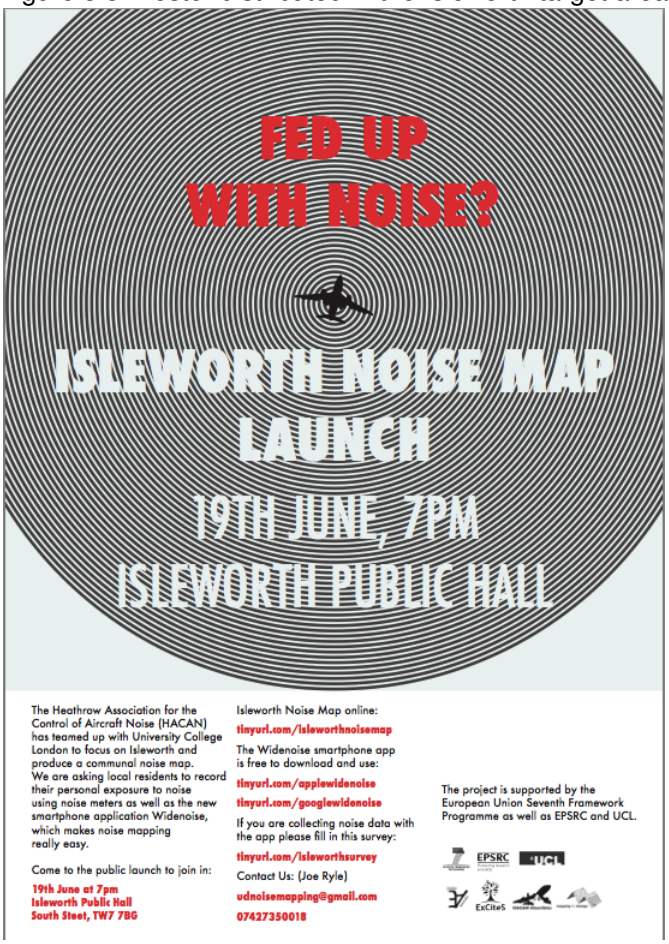

Figure 3.4: BBC Website Article Regarding the Heathrow Case Study

Figure 3.5: Manual Explaining the Usage of the WideNoise Application

increasing the possibility that measurements would be integrated into their daily routine.

While developing the language and methods to address the participants with the WideNoise application, one of the crucial tasks was to communicate the technical specifications of the application. The participants were made aware that the application was not developed by the UCL team but was a pre-existing external application. During the workshops both the graphs and table of raw technical data from section [ISI, 2012] were shown to the participants. The team explained that the accuracy of app using three statements: that the application was giving different results depending on the phone model, was much less accurate than a £30 noise meter from Maplin (a UK electronics chain) and had poor performance below 50 dB(A).

3.1.6 Identifying Participants' Motivation

The Heathrow campaign in Isleworth included three face-to-face workshops over the period of four weeks, with the participants carrying out noise monitoring during this period. The longer-term engagement, and direct communication with participants, offered the EveryAware team the opportunity to investigate participant motivation in greater depth than in the previous Beta Case Studies. Questionnaires were administered to participants both at the start of the campaign and following a four-week period of engagement. The questionnaires are presented in full in Appendix 1, and focused on understanding the participants' general level of engagement with the community, their understanding of noise related issues and their expectations of the project. The pre-project survey was designed to capture the motivation of the participants for attend the workshops as well as gathering context on the background and expectations of the participants. The follow-on questionnaire sought to identify whether participants' expectations had been met, suggestions for suitable noise gathering protocols and their feelings about the accuracy of the WideNoise app as a noise monitoring tool. The pre and post surveys were distributed at relevant workshops in

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Isleworth, which roughly 30 people attended. In addition,they were emailed to all the participant email addresses collected on the day.

During the workshops, interactions between the participants as well as with the project team were recorded as audio files and later transcribed. In addition, observation of interactions with participants or other incidents or events were recorded after each workshop by the investigators.

3.2 Analyzing the Data

As with the Beta case studies, for the analysis of data in EveryAware, a mixed methods approach has been used, combining quantitative methods (as described above) and qualitative methods both to process the pre-and-post participation interviews with participants and survey returns. To identify the Heathrow users in the large-scale case study a geographical boundary was created to delimit the target area and to identify and separate two groups of users:

- WideNoise users within the demarcated area referred to in this document as Heathrow users.
- WideNoise user outside the demarcated area referred to as non-Heathrow.

The long term engagement and specific geographical focus of the Heathrow Case Study permits preliminary investigation into the results of various recruitment techniques, along with a more in-depth understanding of motivation for participation and behaviour change, by combining qualitative and quantitative data. Results of both the survey and in-depth analysis of WideNoise usage over the period from the onset of the case study to date are presented, with a primary focus on recruitment in Section 3.3, quantitative information in this Section 3.4, and the more qualitative information in Section 3.5. Again, it is important to stress that the results presented here are interim, given that the large-scale case study was only launched on the 19^{th} June 2012. They serve to demonstrate the potential of the analysis that can be undertaken as part of the EveryAware project.

3.3 Interim Results - Participant Recruitment

This section examines the responses to the various engagement techniques trialled as part of this project – advertising, and direct engagement via an interest group.

3.3.1 Advertising

The use of specific links for each type of advertising permitted the analysis of the number of responses for each recruitment technique employed as part of the large scale case study. These are summarized in Table 3.1[5]. The advertising spend of £5000 resulted in 199 unique visitors to the landing pages. This results in a spend of more than £25 per unique visitor, without any guarantee that they will install the application and later use it. Amongst the media channels the best performer was the local website banner advert. It is likely this was the case since the website itself is already a place where local discussions about the noise around Heathrow are taking place. Our preliminary analysis of these figures is that advertising is not an efficient way of recruiting participants for environmental pollution monitoring. The advertising company identified an additional issue, which is that any people who did download the WideNoise application would not have a way of connecting to a wider collective campaign in their local area.

[5]Note: these figures include an unknown number of false positive visits from the advertising company and UCL teams during testing. It must be assumed that the number of actual number of app installations is significantly lower than the amount of unique visitors to the websites.

Table 3.1: Table of advertising metrics by media channel (up to 6th Aug 2012)

	Van with advertisement for 1 week in multiple locations	Printed Advert in local newspaper once per week for 4 weeks	Banner advertisement on local website for4 weeks	8,000 leaflets handed out at local train stations
No. of unique visitors	21	9	156	13

> "What I found while using it... I sort of felt - is that it? Its has gone off somewhere but I have no understanding what I have participated in." *Comment from the advertising company*

These findings suggest advertising is not an efficient means to carry out crowd-sourced recruitment of users without further communication with people in the area who are involved in the project. Additionally the design of the application and its ability to connect the individual users of an environmental monitoring tool to a wider community of local users should be one of the design goals for future environmental monitoring tools.

3.3.2 Recruitment Via HACAN

Figure 3.6: Noise Measurements Captured on Campaign Launch Day, 19th June 2012

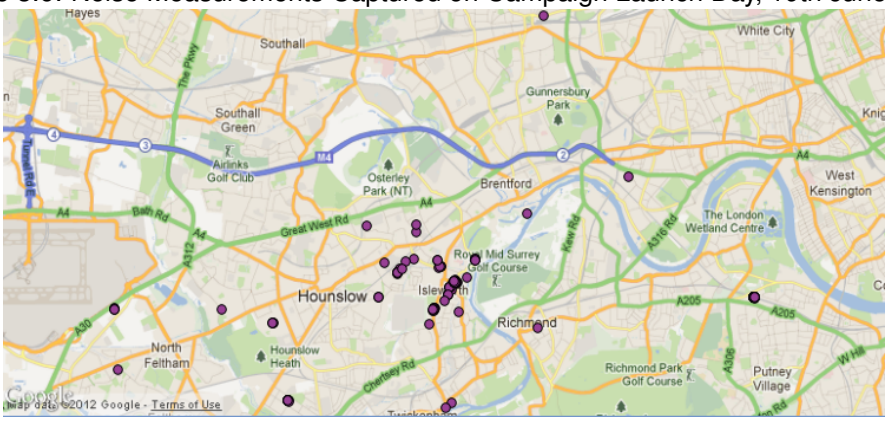

Figure 3.6 shows points captured on the 19^{th} June (campaign launch day) around the Isleworth area. However, as shown in Figure 3.7, which shows the area of greater London, it is apparent that many users downloaded and used the application outside of the project's target area of Isleworth, perhaps due to the TV report (Figure 3.4). This publicity was also important for the project launch in Isleworth, which took place in the evening on the same day. A number of the participants who came to the launch had seen the TV coverage and said that this encouraged them to come to the workshop. This seems to demonstrate the impact of traditional news media to communicate and recruit people within a target area as well as more broadly. The BBC coverage appeared to add authority and credibility to the project and workshop participants mentioned the coverage in an excited way when they arrived at the workshop.

Figure 3.8 shows the importance of the HACAN mailing list, through which, the largest proportion of respondents had heard about the workshop. In addition it demonstrates the efficiency of the printed

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Figure 3.7: Points Captured Across London on Campaign Launch Day, 19th June 2012

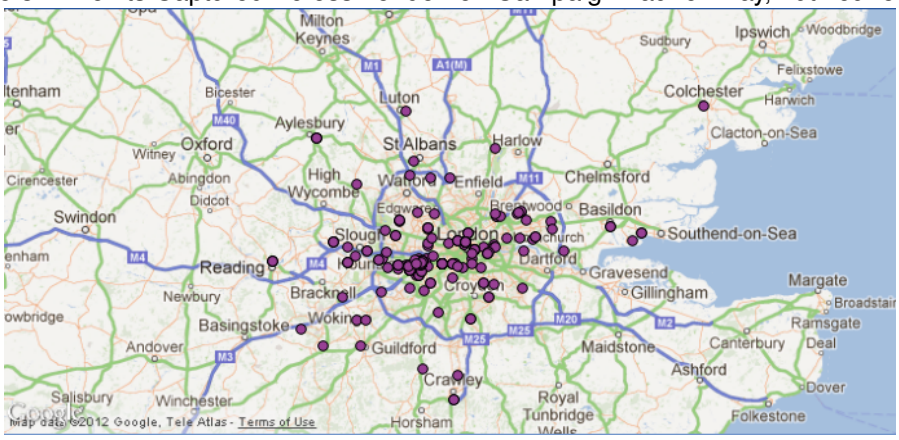
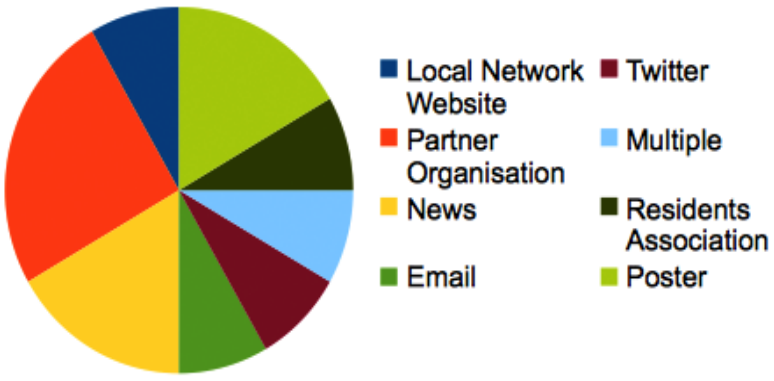


Figure 3.8: Responses to 'How Did You Hear About This Project?'



posters which were displayed in the windows of local shops. The effect of the TV news coverage is also emphasized. In contrast throughout the project, none of the participants mentioned any of the advertising media. Other media that proved useful throughout the project was the newspaper coverage in a number of local papers (Figure 3.9).

Figure 3.9: Coverage of the Project in a Local Newspaper

In summary, the range of means of contacting local people in Isleworth suggests that there is no easy magic bullet for local recruitment and that as many diverse methods as possible ought to be explored. It is also notable that only a single user had heard about the project through social media channels such a twitter and Facebook, and the “Ad Van” did not prove to be value for money. In contrast the effectiveness of ‘old media’ like posters, email and websites should be noted and remembered when setting up future community participation projects.

3.4 Engagement - WideNoise Participants

This Section presents the results of a quantitative analysis of the WideNoise data, and examines issues relating to overall participation level, longevity of participation and levels of activity for both the Heathrow users and the ‘other’ group – i.e. those not capturing data in the campaign area. The results presented here relate both to known participants – i.e. those who attend community meetings and/or are registered to the system, and to those unknowns who are actively capturing data but are not directly known to the project team.

3.4.1 Summary of Heathrow Data Captured to Date

A total of 3159 noise readings have been captured in the Heathrow area to date (including 152 captured prior to the start of the noise campaign on the 19^{th} of June 2012). This compares to 20618 for the rest of the world. These points have been captured by 298 distinct devices, of which 34 are registered users (this includes the devices issued by UCL). 1860 points were captured by iOS devices, and 1299 by Android devices.

In the first week of the Campaign, a total of 621 readings were captured in the Heathrow area alone, with 602 around the rest of the world. The maximum number of points captured by a single

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user in the Heathrow area is 520, with a count of 515 at second place. Both of these counts have been generated by members of the Heathrow community. This can be compared to the top two counts for data outside Heathrow – 712 and 668, both of which have been generated by members of the EveryAware team.

Figures 3.10 and 3.11 below compares the overall number of readings captured by users around Heathrow with those from elsewhere in the world (i.e. not involved in a specific campaign). Calculating the percentages, 13% of Heathrow users have captured over 10 readings, whereas only 1.6% of the general population have done so.

Figure 3.10: Number of Users Versus Number of Readings Captured, Heathrow Area

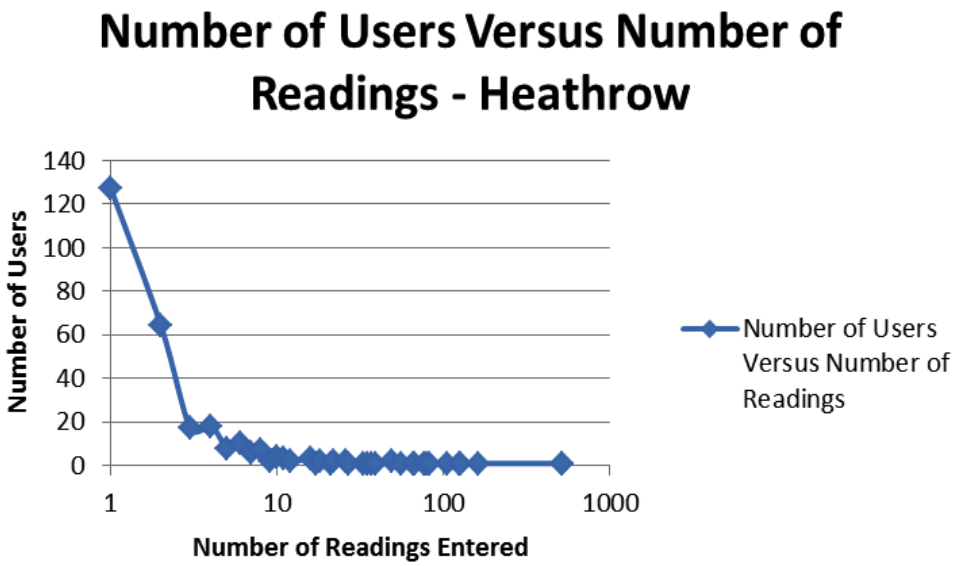
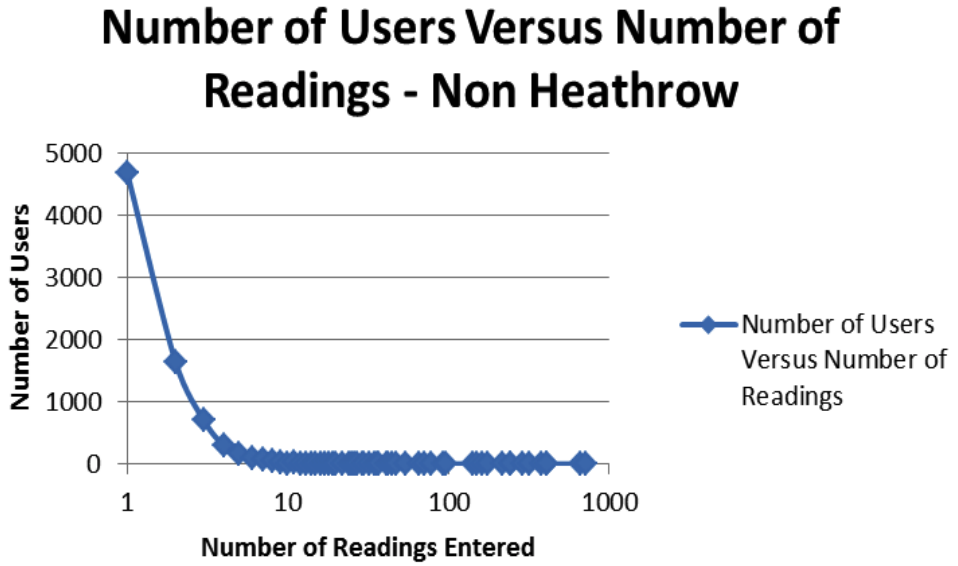


Figure 3.11: Number of Users Versus Number of Readings Captured - Outside Heathrow Area



3.4.2 General Engagement Metrics

Table 3.2 shows three measures where Heathrow users differ significantly from the general public. The majority of the users of the WideNoise application did not register their devices on the

Table 3.2: Table of statistics comparing the engagement of Heathrow and non-Heathrow users

	Heathrow users	non-Heathrow users
Registration Rate	11.4%	2%
More than 10 recordings	13.1%	1.6%
Reading with tags	33.8%	10.7%

EveryAware website, perhaps due to difficulties with the registration process or lack of interest in accessing their own data. Here, we see a significant difference in the registration rate of users in Heathrow and non-Heathrow. Since registration involves some user effort, and allows historical analysis of one's own data, a high registration rate suggests higher user engagement with the data. In addition a larger percentage of Heathrow users took more than 10 recordings and created more tagged recordings than non-Heathrow users. These three indicators suggest that the Heathrow users are more highly motivated to collect data, to review it and categorize it.

3.4.3 When are people measuring?

Figure 3.12: Number of Measurements for Each Hour During the Day

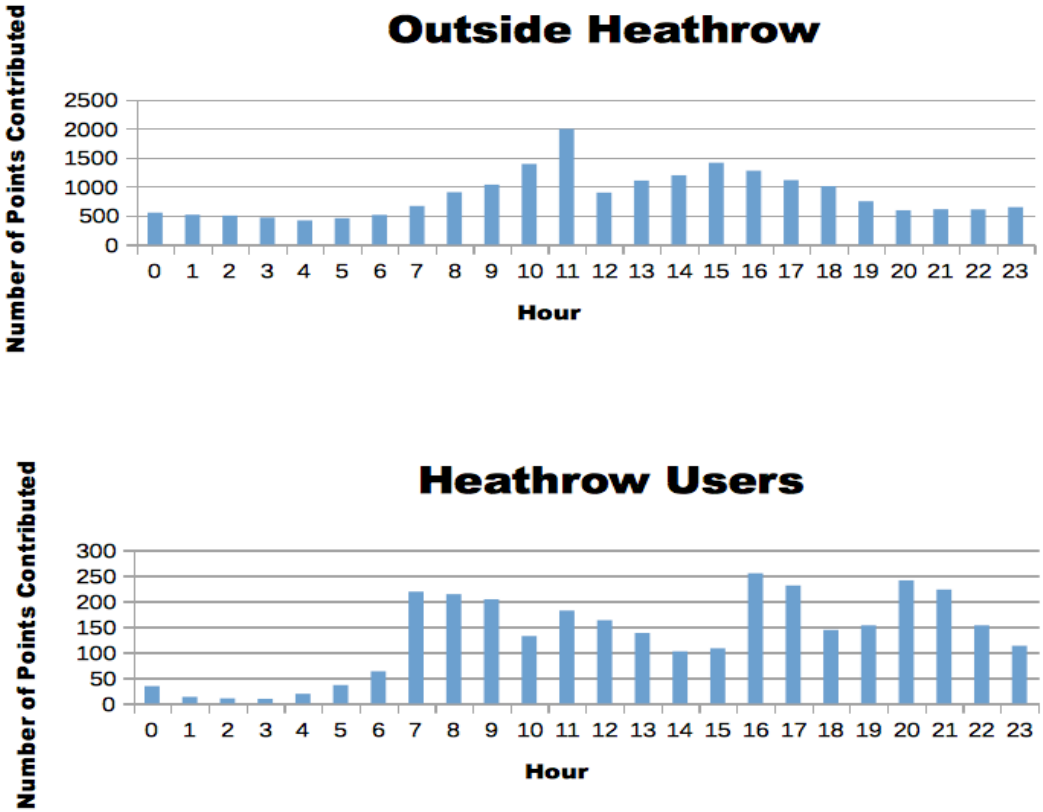


Figure 3.12 shows hourly measurements for both Heathrow and Outside Heathrow. There appears to be significant differences between the two diagrams. The Heathrow diagram shows a morning peak, a late afternoon peak and evening peak. The non-Heathrow diagram shows a strong peak at 11 o'clock and gentle peak in the early afternoon. Examining the diagrams, it is possible to suggest that the Heathrow pattern is indicative of typical work-life activity, with a peak in the morning, a peak just before returning home and then another peak in the evening after-dinner. Interestingly this pattern is not followed in the non-Heathrow user group, where the strong peak is at 11am, which is hard to explain, perhaps indicating use during work time. One possible explanation is that since the

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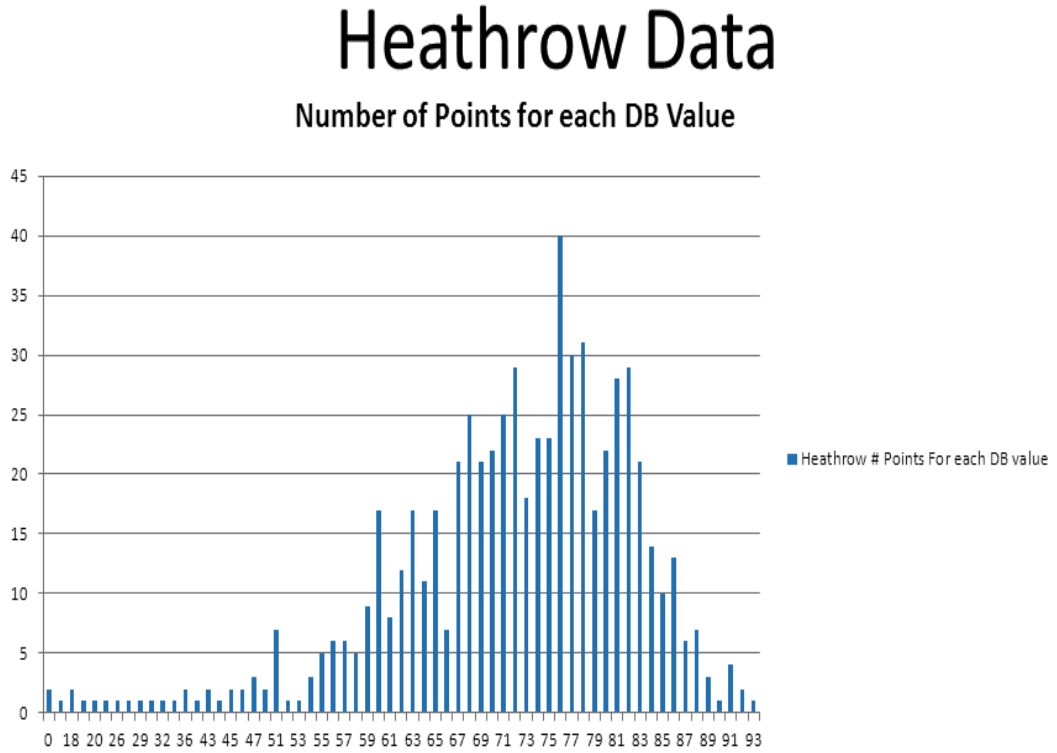
research team data has not yet been removed from the overall dataset, the graph represents test behaviour from the project team during work-time. It appears that amongst the Heathrow users the application was made part of their life being used in the morning, before returning home and after dinner. This is just a hypothesis but appears to fit in with the interviews and discussions with participants.

3.4.4 What is being measured?

Examining the distribution of noise readings across the decibel range (Figures 3.13 and 3.14) it is possible to see that the average measured noise in Heathrow was higher at 71.4 dB versus 61.9 dB in the non-Heathrow area. Particularly noticeable is the spike around 20 dB in the non-Heathrow data which is absent in the Heathrow data. While the technical problems of the WideNoise application might have a role to play, (see [ISI, 2012]), it is likely that the difference between the two graphs indicates a different intention of measurement. It is possible that the relative absence of low recordings in Heathrow suggests that participants purposefully avoided recording low noise and focusing on loud noise recordings. This cannot be confirmed by quantitative examination of the data. Examining the raw WideNoise data, it is not possible to identify the source of noise measured. Tagging is thus an invaluable resource for providing context to noise measurements. Table 3.3 shows the top 15 most popular tags for Heathrow and for other users [6].

Figure 3.13: Number of Readings at Each dB Level - Heathrow



Looking at the tag data for Heathrow we get a sense that the participants are actively trying to measure the noise of the planes and often differentiating between big and small planes and at different

[6]The highlighted tags Heathrow and aeroplane in the non-Heathrow user group, appear to be due to a number of readings relating to the Heathrow airport being taken outside of the Heathrow bounding box. When looking at the location of these readings, it is found that they were taken many km outside of the target area, so it was felt that changing the boundary area was not appropriate.

Figure 3.14: Number of Readings at Each dB Level - Outside Heathrow

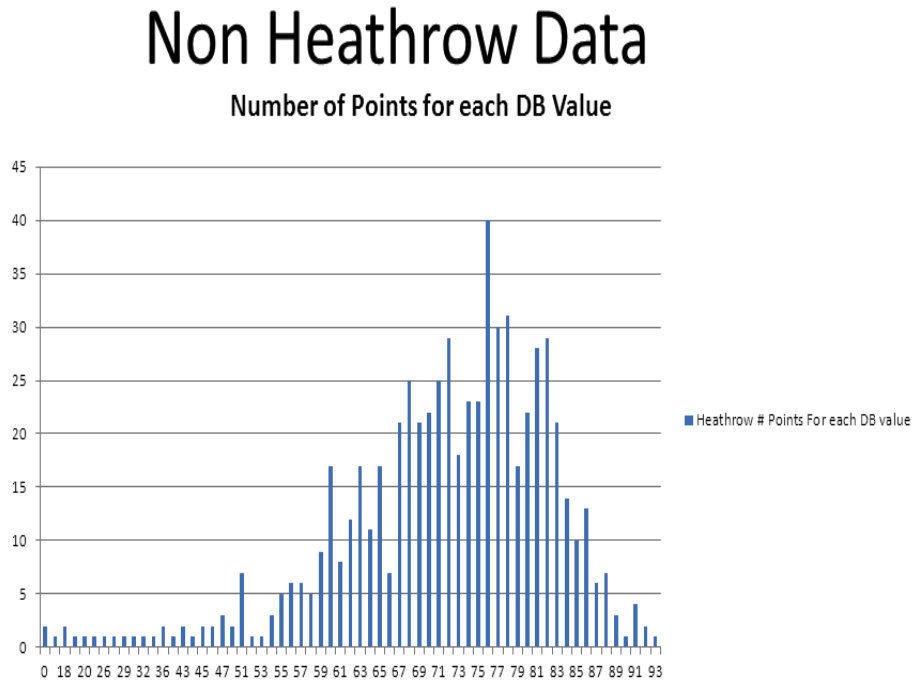


Table 3.3: Table of the top 15 most most frequent tags used for Heathrow and non-Heathrow

Heathrow Tags	Number of time tags is used	Non-Heathrow Tags	Number of time tags is used
Garden	500	car	256
Plane	268	antwerpen	249
Street	78	heathrow	201
Aircraft	63	aeroplane	197
south runway	44	arriva	188
general background	42	office	146
noisy	33	station	137
north runway	31	traffic	124
back garden	23	street	114
big plane	20	eva	101
Heathrow	18	indoor	100
small plane	15	route 62	88
Airplane	15	bus	85
twickenham rd	14	outdoor	84

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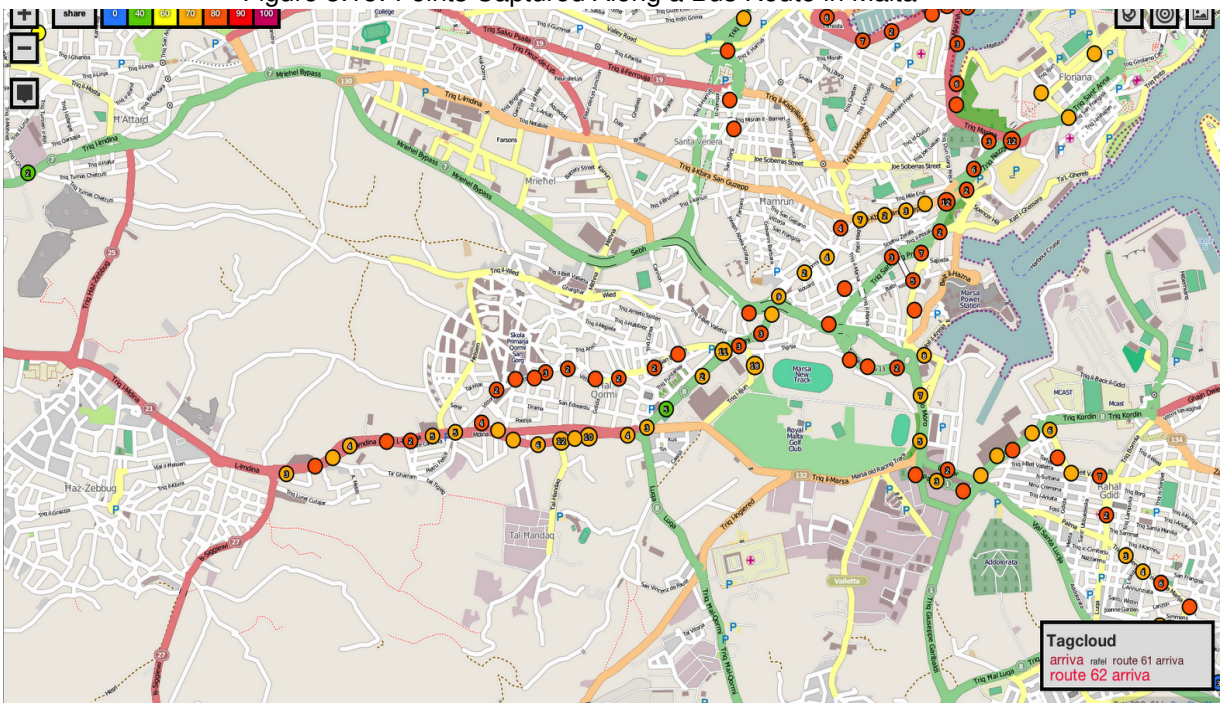
distances as well as which runway they are landing or taking off from. Interestingly the tag ‘general background’ appears high up. The idea of a general background highlights the motivation of the Heathrow participants, for whom the planes are the foreground object of interest while everything else is general background. We also get a good sense of where the participants are monitoring the planes, i. e. mainly in the garden, the street or a named streets or on their balcony.

In comparison the general non-Heathrow tags show a mix of words without any clear focus. In terms of sources of noise the tags ‘car’ and ‘traffic’ appear high up. The tag ‘antwerp’ is used often and related to the Antwerp noise map test carried by the EveryAware project team during a project meeting. Other words like office, station, home seem to indicate that a large number of readings for non-Heathrow users were taken indoors (there are no specific instructions on downloading the WideNoise app as to where to measure). Two interesting patterns emerge through further examination of the tags:

Malta

The tags ‘arriva’,’route 62’, ‘route 61’ are used in close geographical proximity. The tags are used along specific roads and appear to be a coordinated attempt to map the noise of two different bus lines (Figure 3.15). Looking at a map of where these tags were used, the data points show a very similar characteristics to the Heathrow case study of by focusing on mapping a target source of noise, in this case buses. What the map shows is a geographical focus on the the bus routes rather than a dispassionate attempt to map a regular grid pattern. The readings are exceptionally loud (around 90dB) indicating that this is a targeted, ‘engaged’ attempt to capture the intensity of the noise pollution.

Figure 3.15: Points Captured Along a Bus Route in Malta

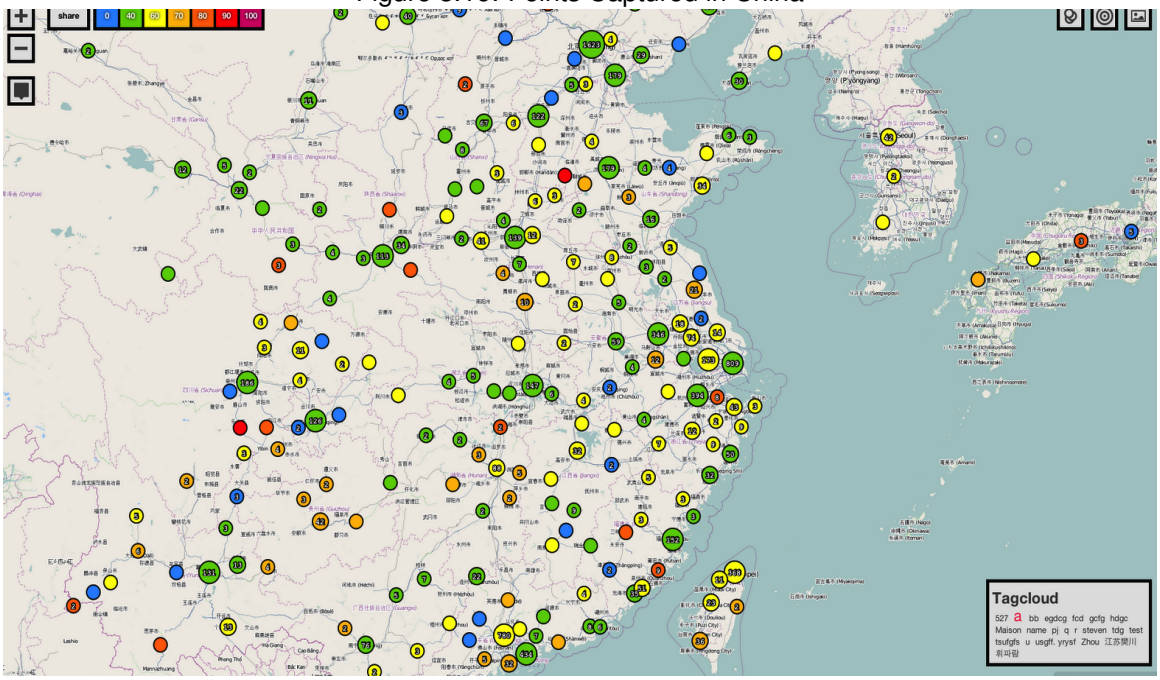


China

Examining data in China (Figure 3.16), the country with the highest amount of WideNoise recordings (8317 in total to date), we see that the density of readings appears to correspond with popu-

lation density. Very few of the readings have been tagged so it is hard to determine why or what the users were recording. The absence of tags suggest that the recordings were not coordinated collective events or perhaps issues with the English language interface. Looking at the noise level of the recordings, the average of 40-60 dB for most cities is much lower than the average of 61.9 dB for the rest of all the data. This combined with the tight clustering of many of the points, suggests that the majority of the recordings were taken indoors. As described in [ISI, 2012] the WideNoise application produces strongly fluctuating readings with low accuracy below 50 dB(A). So despite this large number of recordings in China, the indoor recordings and low technical accuracy might be of low quality for creating urban noise models. In addition the low tag usage and lack of face-to-face contact with users makes it hard to the gauge user motivation or trace behaviour changes. These findings suggest that coordinated campaigns by active users might produce higher quality data for urban interpolation of noise maps.

Figure 3.16: Points Captured in China



3.4.5 Where are people measuring?

Figure 3.17 shows the overall distance (as the crow flies) that users cover from their first capture point. These diagrams suggest that non-Heathrow users tend to measure noise at a single location and then stay within 10 meters distance for any subsequent recordings. This suggests that on the whole, non-Heathrow users did not carry out any geographic mapping of noise. In contrast the Heathrow data shows a much wider spread of distances across the graph, suggest that users are not only measuring their immediate location but also exploring the wider area to map the environment. In the Heathrow data, there is a significant spike in the 100 - 500 meter distance. A distance of 100-500 meters is within comfortable walking distance, suggesting that users might be purposefully going out to map their local area. This hypothesis has been reinforced by discussions during the workshops, where some participants talked about going for walks to map their local area, while others tried to make it part of their daily routine.

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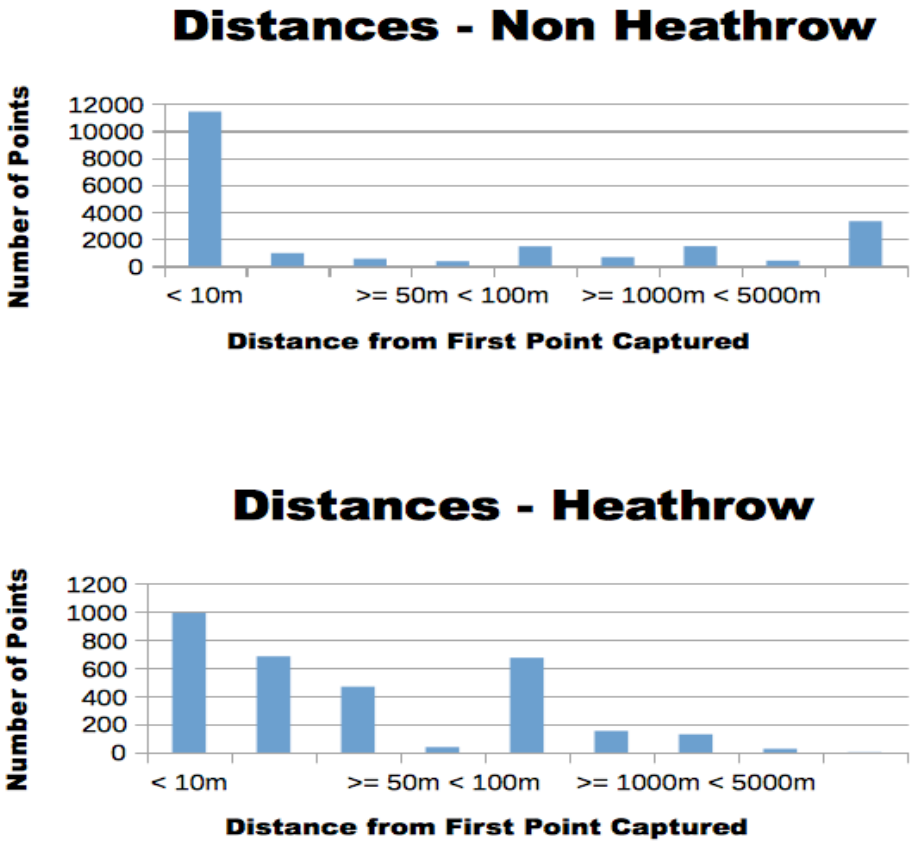
Figure 3.17: Distances of Subsequent Points from First Point Captured



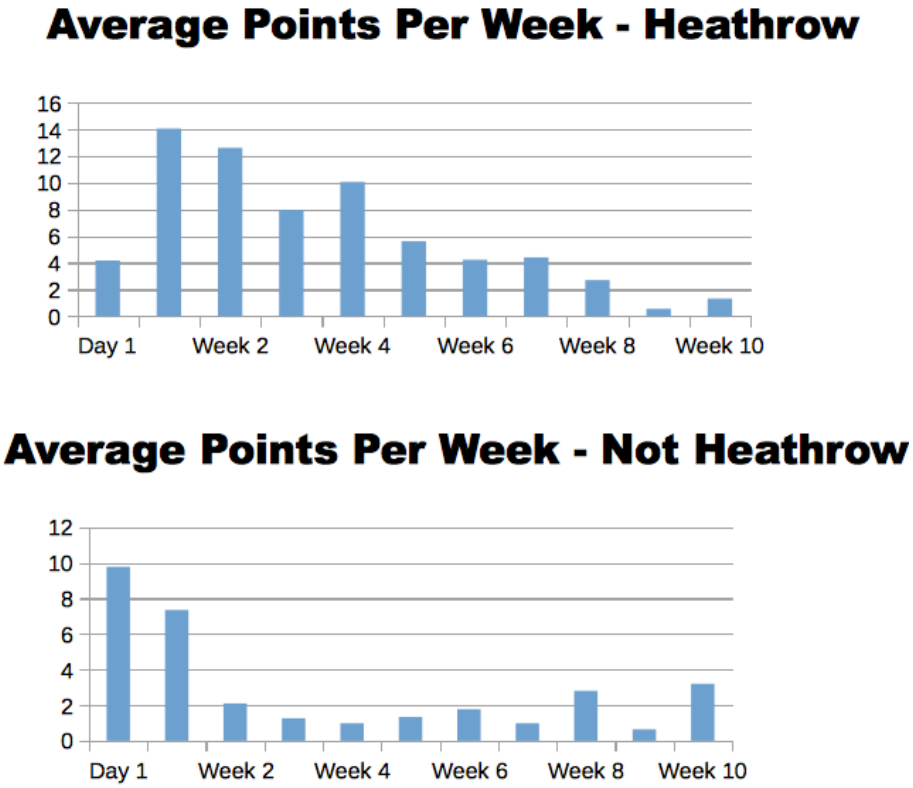
3.4.6 How Long are People Measuring For?

The most prolific user in Heathrow recorded 647 readings If we assume that taking a single reading included going outside to take the reading, unlocking the phone screensaver, opening the WideNoise application and taking the measurement, using the sliders and adding a tag, each reading might take up to 2 minutes per data point, it is estimated that this user spent 1294 minutes (more than 21 hours) on noise monitoring with the WideNoise application. This does not include any time spent looking at the visualization or discussing and thinking about the project. The time investment by the Heathrow users represents an enormous effort and should be valued not just as abstract data points but as a demonstration of the extraordinary level of engagement by the Heathrow participants in the issues of environmental monitoring.

Indeed, the clearest type of change that can be noted as a result of the project in Heathrow, is in terms of the involvement of the local participants in environmental monitoring. The duration of this project demonstrates the potential for longevity of engagement for community environmental monitoring.

Figure 3.18 shows the average numbers of points captured by users within and outside the Heathrow boundary. Comparing these two graphs, there are distinctly different patterns between the Heathrow and non-Heathrow users, on the first day of usage as well as continuing weeks. In Heathrow, the graph shows a sustained period of engagement activity with a gradual decline towards week eight. Outside of Heathrow, the number of recordings declines after the first day and almost ceased after the first week. This seems to demonstrate that the Heathrow community project created sustained participant engagement in environmental monitoring. When we consider that the large majority of participants in the project had never previously taken part in any environmental monitoring then this is quite a change in the lives of the participants.

Figure 3.18: Average Points Per Week - Heathrow and Outside Heathrow



3.5 Engagement – Community Participants

Having reviewed the interim quantitative outcomes in Section 3.4, which provide insight into the wider group making use of the WideNoise app in the Heathrow area, this Section investigates the more qualitative issues relating to recruitment, engagement and longevity of participation, with a focus on those residents of Heathrow who go that one step further and are involved actively in the HACAN group meetings. Issues addressed include: who gets involved in the face-to-face activities (as opposed to the WideNoise data capture) and why? What do these users gain from the project, and what is their understanding of the limitations?

For the pre-project survey (4.1), 12 survey responses were received providing a 40% response rate. For the post-project survey, 18 survey responses were received with an estimated 40% response rate. This figure is approximate since the participant group was flexible and since people joined during the project's run time. The results in this Section provide a greater insight into those observed through the quantitative review, offering the possibility to validate (or otherwise) the hypotheses proposed above, as well as permitting investigation into complementary issues related to engagement and on-going participation.

3.5.1 Who Gets Involved?

The Heathrow campaign in Isleworth consisted of three face-to-face workshops over the period of four weeks, with the participants carrying out noise monitoring during this period. At the first workshop in Isleworth around 30 people attended. The majority of these people, based on project team observations were aged between 50 - 60 years old with slightly more women present than men. Based on the pre-project survey, the large majority of respondents are long-term residents in the area, having lived there for more than three years.

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Additionally, the respondents were actively involved in social and cultural activities in the local area, with more than half being involved in a variety of community groups, residents associations or children's clubs. However, only a small minority of respondents had previously been involved in any environmental monitoring. In contrast, half of the respondents claimed to have some knowledge of the legal and technical aspects of noise monitoring.

3.5.2 Why Do They Get Involved?

During the workshop discussions, it quickly emerged that the excessive noise of the planes from the nearby Heathrow airport was the reason the participants came to the workshop. This is confirmed by the pre-survey, where all of the respondents focused on airplane noise as the main or only, environmental problem of the area. In their descriptions they used emotive words such as *'horrendous'* to describe the noise and '*depressed and angry*' to describe their feelings about the local environment. Apart from the plane noise, the respondents were positive about the local area. While participants have lived a long time in the area suffering from environmental pollution for a long time, they had not been involved in any active monitoring before this campaign. The reason the participants were attended the workshop, was to become actively involved in a collective effort to monitor environmental pollution of their local area.

To try to gauge their wider aspirations for taking part in the project, the pre-project survey asked what they hoped the project would achieve. The respondents answers fell into three separate categories. The first hoped to carry out structured data gathering that can relate to official noise data.

> "Document actual noise levels rather than the theoretical ones that BAA (British Airport Authority) provide." *Isleworth Respondent*

The second group were attempting to raise awareness communicate the unpleasant experience of the noise as illustrated by this extract:

> "Greater recognition of impact of noise especially the frequency of interruption by planes" *Isleworth Respondent*

The third group were aiming to create direct political pressure though this campaign as illustrated by this extract:

> "Raise the bar for politicians thinking about the 3rd runway" *Isleworth Respondent*

From conversations with the participants there were strong overlaps between these three positions, as illustrated in this extract:

> "Make politicians realize what we suffer. And have scientific evidence of the harm being done" *Isleworth pre-survey respondent*

This quote appears to summarize the motivation of the participants for getting involved in the project. The participants are aiming to collect scientific evidence of their suffering to demonstrate this suffering to politicians. This type of formulation occurred multiple times in discussions with the participants.

3.5.3 The Importance of the Tool as a Motivator

During the launch John Stewart from HACAN gave a talk where he discussed the importance of easy and cheap access to the monitoring devices as one of the reasons HACAN as an organization wanted to work with UCL.

> "Years ago when HACAN had a noise meter of its own, people all over London and beyond were saying, can I have a noise meter in my back garden? Because technology it was quite difficult to install, that's why we were so keen to work with UCL because on a phone it's easy to work."

John Stewart also argues that the tool was also a motivating force for the participants.

> "Certainly, the app is popular I mean there is people... not just in Isleworth but elsewhere. Clearly people feel a need to measure the noise themselves because there is a lack of trust in BAA and the authorities. Even though BAA have got a lot better in measuring the noise - its probably pretty accurate. That is not people's perception. They are grabbing this tool as something to give a result. Certainly there is a need out there, people are wanting it. "*John Stewart, Chairman of HACAN*

This desire for technical tool that can address the political issue of noise pollution is affirmed by the observations of the project team of interactions with the participants. Rather than just being an abstract political issue that requires debate, noise is something the participants wanted to find a way of 'grabbing' in the form of a tool as suggested in the above quote by John Stewart. The environmental monitoring device appeared for the participants to function as a weapon to symbolically combat the noise. Due to this focus on the device the usability issues of the WideNoise tools appeared to be emotionally charged, with most of the second workshop being taken up with participants enthusiastically interrupting and talking on top of each other in their discussion about the WideNoise issues

> "I don't have a phone let alone a smart phone. It was too small, I can't read it - I now know what it says so I am doing it by memory, and I am not used to using it but yeah, using the keyboard (laughter) could you get little pens with it? As far as the actual app, apart from it sometimes has an error sending the tag and occasionally sending things and mostly it sort of worked, but it is the manhandling of it. But I am not used to manhandling horrible little things like that." *Isleworth participant*

The importance of the device must be seen in relation to the user group in Isleworth who were in the 50's and mostly not technically literate. Most of the participants did not have a smartphone and wanted to borrow one for the duration of the project from the UCL project team. Some of the participants did not even have a telephone number or e-mail address. For them a key motivation in taking part in this project was not only environmental monitoring but also access to the highly technical and expensive mobile phone platform that would allow them to carry out the environmental monitoring. Those that did have access to their own smartphone often commented that installing the application was often difficult and hard to use. The android smartphones that participants owned were old models with slow processors and small screens that made the app information hard to read [7].

3.5.4 What Triggers a Measurement Process?

The hypothesis presented above was that users were taking measurements in particular when loud planes were passing overhead. This was confirmed anecdotally by conversations with the participants, many of whom purposefully recorded only peak noise. Their motivation was to demonstrate the noise level of the planes so they are mainly recording these noisy events and taking much fewer quiet recordings.

> "I didn't bother sending anything anything less than 75 decibels" *Isleworth Participant*

[7] A more detailed discussion on the usability issues with the WideNoise application can be found in [UCL, 2012].

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However, taking this approach did not meet with universal consensus amongst the the Isleworth participants, some of whom argued that participants should also record quiet sounds to contrast the planes. On the whole there was some confusion amongst the participants about the overall aim of the noise mapping campaign. This quote illustrates this well:

> "What are we aiming to achieve? I assumed it was high-decibel recordings. In which case, it seems to me that ongoing averaging will kill us, if anyone else does/has done what I've done – i.e. a few random aircraft overflights monitored to start with to check the system is working properly, rather than starting off by recording only the noisiest aircraft!" *Isleworth participant*

The reference to averaging refers to the currently used official standard for noise which uses L_{DEN} a 24 hour average with day, evening and night values (see [VITO, 2012]). Many of the participants rejected the usefulness of this averaged noise level and proposed that peak noise should be measured.

3.5.5 Is There Understanding of the Limitations of the Project?

As described above, given the accuracy issues encountered during the calibration of the WideNoise tool (see [ISI, 2012] for further details), it was felt important that it was made clear to end users that the app did not provide highly accurate results. Interestingly, participants did not respond as expected – instead, they showed gratitude for having being shown the data. For many of the participants it confirmed their personal suspicions about some of the abnormally high readings they had taken during the night. The consensus appeared to be that this poor level of accuracy was a problem but there were reasons to continue monitoring with the application. Based on the post-project survey, the majority of participants argue that accuracy of the WideNoise application is essential:

> "Two decimal places unnecessary, but a reliable, pretty accurate figure is surely ESSENTIAL or there is little point to the exercise!" *Isleworth Respondent*

Yet during the workshop discussions the accuracy of the device was not the main topic of discussion and people's position were much more complex and nuanced:

> "It will never stand up in court to the levels taken by professional microphones, but is great for the general awareness of the level." *Workshop Participant*

The level of accuracy of the WideNoise application was not something the participants were concerned with for themselves but only in terms of how credible the resulting data would be with the authorities. In this way the technical accuracy of the device was only relevant in terms of a political understanding of the environmental monitoring project they were conducting. This issue is central to understanding the participants' motivation in taking part in environmental monitoring. The participants on the whole were not motivated by the goal of creating highly accurate but abstract noise data but rather try to influence the political process which was the key to environmental pollution in their area.

3.6 Preliminary Investigations into Behavior Change

Although very much an on-going Case Study, the work carried out with participants and the understanding gained from both the quantitative and qualitative analysis of the Heathrow datasets provide the opportunity for preliminary investigations into whether any behavior change has been

caused by participation in this study. It is important at this stage define what is meant by behavior change. As argued in the literature review, it is important is to use an expanded concept of change that allows the identification of multiple types of change. These changes might be small or large and happen at different levels of intensity for the participants, organizations, the researchers, the local area as well as the wider discussions. This section identifies a variety of these changes caused by the large-scale case study in Heathrow.

3.6.1 Changes in Daily Activity – Recording Noise

As has been seen in previous Sections, over 200 people in the Heathrow area are contributing data to the WideNoise map, some of whom very actively. For the latter group in particular, this has resulted in changes to their daily activity - in particular if they stop to record noise at particular points in time, for example when loud planes pass overhead. Given that a single recording using WideNoise can take up to two minutes (if the app is not already launched) the overall contribution of time could be significant for active participants. Users are, in general, also following instructions to go outside to measure noise, adding to the overall time taken. Additionally, a number of users, having registered to the system, are taking time to access their personal data online. These activities represent, to a certain extent, daily changes in routine and behaviour resulting from participation in the project.

3.6.2 Changes in Awareness of Noise Issues

Based on the post-project survey and interviews with participants there has been a marked change of personal awareness as a result of the project. When this question was asked, it is clear from the responses that the participants are all acutely aware of the noise already but that for the participants, the project added additional layers of understanding to the local pollution issue.

> "I have always been aware of noise as I believe my neighborhood is a very noisy one though I think this project heightened my awareness of how, when and where it intrudes on day to day life." *Isleworth Respondent*

From the interviews it is possible to see that the project has focused the participants' attention on the small and less often noticed aspects of noise. For these already engaged participants, the issue is not one of becoming aware to the issue of noise, but rather a heightened focus on specific characteristics of noise such as the high frequency of landing planes, the interval of planes at different times of the day and sound reflections of noise. The following quote describes an early morning encounter of of the participants had with a plane, with the sudden awareness of noise reflections and the loudness of background noise.

> "I caught the first - I was quite proud of myself . I caught the first plane at 4am I was doing something in the house. Then I heard a plane coming, so I rushed out then I realized what happens is that. . . I live in Thornbury road. First we get the noise from the reflection of the plane from the houses opposite (collective participant 'yes!') and then the actual planes over. I wasn't aware of that and also I wasn't aware of just how. You know. I am in the so called 65 decibel corridor. I was really surprised at 3 o'clock with no planes I could be measuring 60 decibel. So there are lots of things I would have loved to have commented on." *Isleworth Participant*

What can seen, is that the project has created a more detailed understanding of a pollutant for people who are already acutely aware of the issue. This can be seen as a successful engagement since it demonstrates the high quality experience the participants had in taking part as well as the high level of engagement provided by the project.

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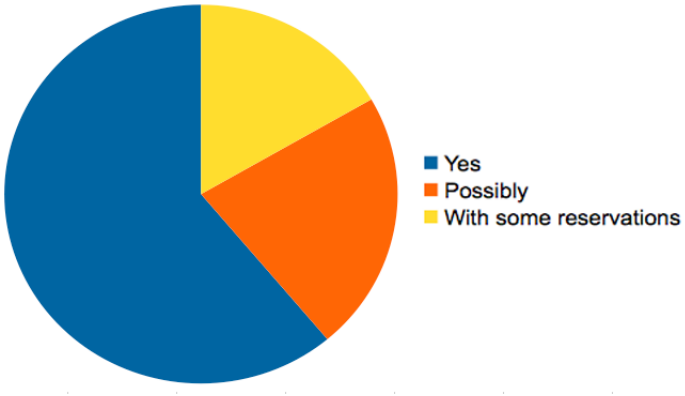
3.6.3 Changes in Longer Term Activity – Participation in Other Projects

Figure 3.19: Has this project encouraged you to take part in future environmental monitoring projects?'



The post-project survey demonstrates that a large majority of respondents have been encouraged to take part in future environmental monitoring projects (Figure 3.19), perhaps indicating they they understand the overall relevance of environmental monitoring and potential impact it could have.

3.7 Interim Conclusions

The large-scale case study provides strong evidence that the methodology of setting up and facilitating an issue based community campaign has a number of advantages over a crowdsourced engagement model.

It also appears that the Heathrow users made environmental monitoring part of their daily life and carried out monitoring over a wider area than the crowdsourced users. The Heathrow users collected large amounts of data over a sustained period of time, which was enhanced with rich contextual meta-data. It appears that the Heathrow users addressed had a deeper and more sustained level of engagement. The users reported new awareness and understanding of the pollution issue. In addition the campaign appears to have helped create deeper and more complex local discourse on the issue of the environmental monitoring.

In contrast to the crowdsourced model of participation which focuses mainly on the engineering of the technical tool for environmental monitoring, the Heathrow campaign was a complex assemblage [Latour, 1987], comprising of many disparate elements, such as the UCL researchers, HACAN, the specific workshop location, the WideNoise tool, as well as Heathrow and the participants themselves. It is important to avoid equating this complex assemblage with the WideNoise tool. As this case study seems to demonstrate, what is needed for future research is to build more environmental mapping assemblages which are co-designed with issue based campaign organizations and engaged groups of users.

As noted above, the Heathrow case study described is part of an ongoing activity and will continue with a second element located in and around Heathrow Villages which are right next to Heathrow airport and have slightly different environmental issues with noise and air pollution from the airport. It will thus be possible to collect more data and confirm the current findings on motivation and change. A specific aim of the second part of the large case study is to compare the effect of introducing a more prescriptive data gathering protocol. Its aim will to provide better spatial and temporal coverage of the area to enable improved interpolations for noise modeling. The new protocol will ask participants to take measurements at set points of the day and to measure the

sound occurring at that point in time and space. This protocol will be much more restrictive than the one used in Isleworth which merely asked the participants to measurements outside. The further research, will evaluate what effect this prescriptive data gathering protocol will have on the motivation of participants, as well as on the data coverage in space and time of the data gathered.

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Chapter 4

Appendices

4.1 Appendix 1 - Isleworth Pre-Project Survey

This survey is designed to collect some basic information about you and ask why you got involved with this project. Near the end of the project we would like to ask you to fill in a similar survey so that we can evaluate this whole process.

The survey should take no more than 5 minutes to fill in. All personal information will be removed and only used used for academic research as part of the European Union research project EveryAware.

If you have any questions about this survey contact - Christian Nold.

email: c.nold@ucl.ac.uk

phone: 07946640395

1. Your Name
2. Your Email
3. How long have you lived in this area?
4. I don't live here Less than 1 year, 1 - 3 years, More than 3 years
5. How did you hear about this project?
6. How do you feel about environmental quality in Isleworth?
7. What do you hope this project will achieve?
8. What do hope to personally gain by participating in this project?
9. Have you been involved in any environmental monitoring before?
10. Are you involved in any other local activities in Isleworth?
11. Are you aware of some of the technical and legal aspects of noise?
12. Are you going to use your own phone with the Widenoise app?
13. Yes, No, No, I would like to borrow a phone from UCL

4.2 Appendix 2 - Isleworth Post-Project Survey

Now that the project has finished we would like to ask you what you thought about the the overall process of the Isleworth Noise Map project.

The survey should take no more than 10 minutes to fill in. All personal information will be removed and only used for academic research as part of the European Union research project EveryAware.

If you have any questions about this survey contact - Christian Nold.

email: c.nold@ucl.ac.uk

phone: 07946640395

1. Your Name
2. How has the project affected your awareness of noise?
3. Did you personally gain anything by participating in this project?
4. What do you see as a realistic goal for a communal noise monitoring project?
5. Did this project achieve what you had hoped?
6. How important is the level of accuracy of the Widenoise application?
7. What other kinds of devices might be useful for dealing with the noise issue?
8. Has this project encouraged you to take part in future environmental monitoring projects?
9. Do you have any other comments?

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