Solutions, strategies and frictions in civic hacking

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Abstract

Through the development and adoption of technical solutions to address city issues the smart city seeks to create effortless and friction-free environments and systems. Yet, the design and implementation of such technical solutions are friction-rich endeavours which produce unanticipated consequences and generate turbulence that foreclose the creation of friction-free city solutions. In this paper we argue that a focus on frictions is important for understanding civic hacking and the role of social smart citizens, providing an account of frictions in the development of a smart city app. The empirical study adopted an ethnographically informed mobile methods approach to follow how frictions emerge and linger in the design and production of a queuing app developed through civic hacking. In so doing, the paper charts how solutions have to be worked up and strategies re-negotiated when a shared motivation meets differing skills, perspectives, codes or designs; how solutions are contingently stabilised in technological, motivational, spatiotemporal and organisational specificities rather than unfolding in a smooth, linear, progressive trajectory.

Key words: friction, solutions, strategies, civic hacking, apps, smart city

Introduction

A challenging issue that emerges with smart city initiatives concerns the production and pursuit of technical solutions. These initiatives are transforming contemporary cities beyond simply the amount, speed and diversity of the data that can be automatically generated by sensors and humans, and in making infrastructures and services more efficient, productive and competitive. More profoundly, the 'deep analytics', developed and deployed by companies such as IBM (2012) and Motorola (2013), provide a different kind of governmentality wherein algorithms and predictions can be trained and improved with real-time data and domain expertise, and urban issues can be resolved, or better yet pre-empted, with optimised and automated mechanisms of solution generation. A smart city therefore is not only an efficient city. It also seeks to become a friction-free city where organising commuting, environmental protection or neighbourhoods will be effortless. The erasure of friction will be facilitated by 'solutionism' (Morozov, 2013), wherein complex and contingent systems are disassembled into component parts and neatly defined assumptions and tackled with technical solutions rather than political and policy responses. Here, cities and individuals are replaced by simplistic suppositions about how to design and manufacture cities, governments, citizens and consumers (Zwick & Knott, 2009; Vanolo, 2013).

In the main, such innovative city solutions are envisaged as being provided by companies rather than public bodies. However, the public are also not short of innovative strategies and solutions to respond to difficult problems. In the context of emergency situations, for example, 'voluntweeters' comprising computing scientists and volunteers create virtual 'disaster desk' that mobilises core members and other local and global volunteers to collect, translate, organise and verify tweets for providing fast, reliable and effective ways of situation awareness and resource coordination (Starbird & Palen, 2013). WiFi publics, including artists, activists, geeks, students etc., provide community owned and maintained communication channels by engaging in the infrastructure setup, augmenting local communities and discourses on the political implications of community WiFi (Powell, 2008). These are only two of many other cases where individuals motivate and organise themselves to gain deeper understanding of science or engagement with computing technologies for envisioning and building alternative futures for pressing community, humanitarian or environmental issues.

In various ways, voluntweeters and wifi publics are partial solutions to the issues that motivate their endeavour. Further, their strategies often inadvertently result in further challenges to their causes. This partiality of solutions is unavoidable and the untidiness in the field of operating strategies and organising participations can be more widely shared and further conceptualised. As Urry's (2014) reworking of wicked problems demonstrates, the effort of designing and producing future cities is always situated in complex interdependencies in which one solution reveals or creates further problems and the conditions of defining problems and sourcing solutions can inform each other and change over time. This friction-rich journey of working up solutions and adjusting strategies is particularly important in civic hacking where a complex and interrelated urban issue can ‘hack’ any reductionist software/hardware solutions and imaginaries (Sassen, 2012).

This paper provides an empirical account of such frictions and argues for their theoretical significance in conceptualising civic hacking and social smart citizens. The research adopts the ethnographically informed approach of mobile methods (Büscher et al., 2014) to follow how frictions emerge and linger and thus how solutions have to be worked up and strategies re-negotiated when a shared motivation meets different skills, perspectives, codes or designs under the context of civic hacking meetups. For example, in one meetup, a police representative was invited to participate allowing one of the projects to get a sense of how they might obtain necessary data and improve their algorithms and prediction results for wait time in a government office. The session, however, was turned into energised discussion about all sorts of possible and technologically enhanced solutions for acquiring data, and the regulatory difficulty, legal and technical concerns, and practical and organisational issues that could emerge from those possible solutions. The lessons were learned by the project members, and became their local knowledge and even ‘collective memory’, refreshed when new members joined and asked why there could not have been a more brilliant solution than using unreliable, crowdsouced data captured from Foursquare and Twitter, and from other opportunistic, ‘guerilla’ data collections. To further analyse this and other projects and the solutions they pursue, the paper draws on science and technology studies, anthropology, design studies and CSCW literature to unpack the necessary relationships between solution and friction (Tsing, 2005; Suchman, 2011).

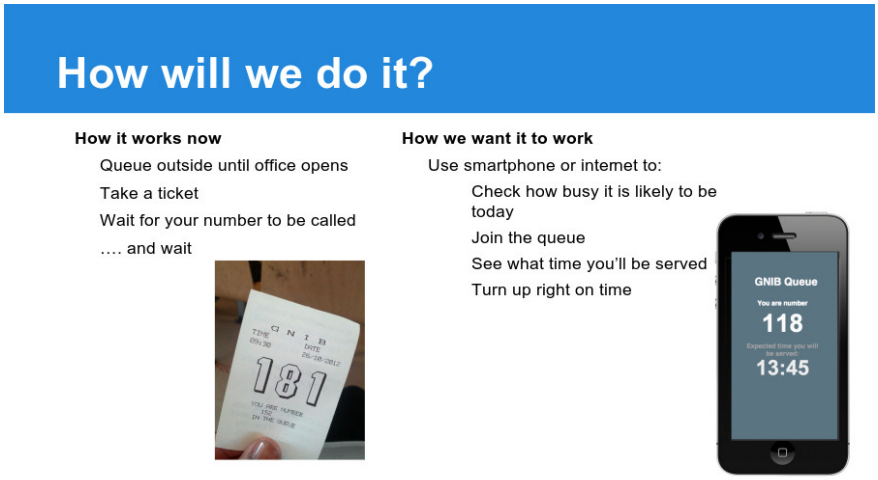
The case study

This empirical focus of the paper is the meandering process of developing a queuing app in a friction-rich process, by drawing from ethnographic research that follows how solutions are worked up (Büscher et al., 2014) at various civic hacking events during 2014 and 2015 in Dublin. The initiative in question, Queuing App, is one of the many projects that are currently pursued by Code for Ireland members. The rationale and idea behind the project are relatively straightforward. The project leader is an immigrant who shares a similar sense of frustration with nearly 97,000 other immigrants living in Dublin with respect to the long wait in the GNIB (Garda National Immigration Bureau) office, where immigration registration and renewal take place (Central Statistics Office, 2011). For these people, a trip to the GNIB office in Dublin requires a pre-registration for the day of their visit, to turn up on the day to collect a number sheet, then a long wait to be called for processing. The GNIB office runs a first-come-first-served system, and thus queues can start to form outside of the office well before it opens and the experience is a collectively shared pain. Social media are often the place where applicants express their discontent, albeit in light-hearted ways. One applicant started queuing around 6.25 am and felt 'awesome' being 'the first 10 people' in the queue; at 7.30 am, another reported that there were 'already THOUSANDS' in the queue; yet another commenting ironically on the growing of an international community 'known as the #GNIB'[1].

The aim of the Queuing App project is to provide an estimate of queuing time, as demonstrated in Figure 1, so that these applicants can better manage their time, or simply wait elsewhere and return to the office when it is their turn. The project is pursued as part of Code for Ireland, Dublin chapter, which organises monthly meetups to attract technologists and people in the community or government to meet, network, identify problems and explore solutions. As a civic organisation, the ideas of transparency and inclusiveness are foregrounded, which have implications on how participants are encouraged to contribute their skills and how individual projects make progress (Maalsen & Perng, in press). In terms of 'the solution' for the Queuing App project, it has gone through a number of sessions of brainstorming, discussion, negotiation and adjustment. After the first two meetups, the participants identified their working solution to

[1] Discussion obtained from querying Twitter search website (http://twitter.com/search-home) using the keyword and hashtag GNIB, and the tweets quoted above were posted between 2013 and 2014.

Figure 1: GNIB queue solution



be the design and implementation of a GNIB office 'Queuing App' to provide queue time estimation. They planned to create an API to transform the data they obtained via a Google form, process them in a spreadsheet to validate the input, and calculate the wait time by considering a range of factors (e.g. day of the week, numbers of tickets issued already, average processing time per ticket on the day, etc.). The validation and calculation result can then be viewed in a dynamically refreshed webpage to show when each ticket holder is likely to be served, and in the app version push notifications can be sent to the users reminding them to go back the GNIB office. Also, a text message version of receiving input and communicating results was suggested and investigated to serve non-smartphone users.

The remainder of the paper focuses on the meetup where the project leader invited a garda, an Irish police officer, who has a background of IT and various police work, to participate in the event and flesh out their plan. This session quickly turned into a series of explorations, frustration and confusion, leading the project to undertake an approach that has little technological sophistication and requires significant communication with relevant government agencies, individuals in the queue or shops and cafes near the GNIB office. This resonates with the process of urbanising technology (Sassen, 2012) where a particular technical solution is energised by sociotechnical expectations about the efficiency it can create and then 'talked back' due to a number of issues: the willingness of the people to share, contribute and donate their skills, the complexity of a city, its path dependencies, bureaucracy or simply the unwillingness to

change. Accordingly, in this paper, we seek to articulate the uneasy relationships between government agencies, technologists participating in civic initiatives, openly created and shared code, and different expectations involved in shaping ‘the solution’.

To further make sense of such relationships, the next section discusses civic hacking using the lens of 'frictions' and the following section explores how frictions arise during the attempt to align government agencies, technologists, codes, technologies and innovation, as well as subsequent problems they then generate. Civic hacking events provide a ‘place’ for the encountering of the above actors and the messy and sticky relationships emerging from these encounters are crucial to start unpacking practices of designing solutions.

Solutions, innovations and frictions

Hacking within the context of free and open source software have different genres (Coleman & Golub, 2008), and civic hacking is underpinned by the values of transparency and access. Critiques of civic hacking include its effect of shifting responsibility away from the government for dealing with issues (Johnson & Robinson, 2014) and also the homogeneous demographics behind the solutions put forward, which is a more general concern for any crowd-based initiatives (Brabham, 2008). Moreover, individualised interests and initiatives can be treated as wider urban problems and thus the problems, what constitutes the civic, and the design of solution can become problematic (Mattern, 2014).

Taking Mattern’s point further, the process of designing and innovating solutions in civic hacking requires careful rethinking. An anthropological study of design and innovation can be useful here, for several reasons. First and foremost, drawing on postcolonial scholarship, it is argued that innovation develops from contingent and uncertain situations. A knowledge- and investment-intensive hub of innovation is enacted by particular and specific sociomaterial arrangements to sustain it as a precarious centre (Redfield, 2002). In a similar vein, the ‘origin’, the defining moment and the progressive trajectories of development all have to be critically re-examined to attend to the promises and imaginaries articulated through and enabled by the practices and micropolitics within design and innovation (Suchman, 2002). More often than not, mis-aligned aims, identities and practices lead to negotiations that acutely reveal that ‘progress’

is seldom a streamlined and linear process and willing and unwilling adjustments have to be made in order to draw out a solution that can be accommodated by differently involved individuals, cultures and organisations (Davies, Tybjerg, Whiteley, & Söderqvist, 2015).

This brings us to the notion of friction initially proposed to understand the global connections of science, capitalism and politics and how the pursuit of their universal dreams, claims and knowledge are situated in the friction-rich, 'sticky materiality of practical encounters' (Tsing, 2005, p. 1). For Tsing, these global connections attempt to achieve their claims of universality by acquiring content and force within specific historical and local conjunctures. To become universal is to travel across differences, therefore the encountering with local specificities becomes an important site where widened and new arrangements of knowledge, cultures and ideas emerge, which change and charge them, enabling them to move across different cultural aspirations, and yet with the impossibility to specify definite courses and consequences:

> Friction makes global connection powerful and effective. Meanwhile, without even trying, friction gets in the way of the smooth operation of global power. Difference can disrupt, causing everyday malfunctions as well as unexpected cataclysms (Tsing, 2005, p. 6).

Civic hacking operates in quite different social and technical contexts than environmental protection, from which the metaphor and arguments are developed. Nevertheless, friction provides an effective framework to start articulating the encounters among the individuals, governments, codes and technologies enmeshed together through the Code for Ireland initiative. The following discussion provides an initial analysis of the frictions emerging from such encounters and the different kinds of problems that are only partially solved, in ways participants expected or unexpected, as well as creating new problems that have to be dealt with when the project carries on.

Remaking queues in the city

The Queuing App project has had participants with various skills and backgrounds joining and leaving the project since its inception. The diversity of the participants has shaped and adjusted

the strategies adopted at various stages of pursing the solution that the project established in the first few meetups. One of the most important meetups was when a conversation with a garda became possible after several attempts of contacting the police, explaining the motivation and inviting them to discuss the idea. In the meetup, the preparation beforehand facilitated the discussion with the garda. However, this does not mean a smooth propagation on the project's agenda for the day. Rather, the ideas and questions prepared for the meetup were instrumental for the project to try and explore alternative solutions when the one being pursued hit a wall. More importantly, by working out what is technologically, organisationally and operationally (im)possible, this rather short and circulatory process of probing and redirecting questions for the garda sustained frictions between the individuals, organisations, passions and coding capabilities that firm up the proposed solution of the Queuing App project and various strategies created at later stages to support it. This section provides a glimpse of such processes of working and firming up 'the solution' through mutual frustration and necessary optimism.

Before the project met the garda, the participants had already had several ideas in mind that they wanted to try, test and implement, which all required obtaining relevant data to start calculating estimated wait time. Without knowing exactly what data they could obtain from the government, the participants started by sizing up the types of queue related data the GNIB office might have and how these data could potentially be transformed into useful estimations. Therefore, the first challenge they faced was turning chaotic queues and the obscure, if not entirely unavailable, sources of data into a streamlined process of estimation.

Clues from the photos of the ticket, which applicants received at the GNIB office and which circulate via social media, e.g. Foursquare and Twitter, were worked on to extract useful information. Printed on the ticket, photo on the left in Figure 1, include the date and time when the ticket was issued, the number an applicant is assigned, and the number in the queue. From these data, the following information can be deduced: the number of applicants arriving before a specific ticket is issued (from the assigned number) and the number of applicants who are still waiting to be served (number in the queue). Also, the date and time provide contextual information about how long the office has opened and the speed of processing applications on that day.

The information extracted from ticket photos can start to generate a rough estimation of wait time. The photos are a reliable source of data in the sense that the date, time and numbers can be clearly captured. But the problem is that the number of available photos is too small to roll out the estimation and respond to the dynamic nature of queues: busy hours and seasons or complexity of particular applications can seriously affect the time other applicants have to wait. The logical solution to this is to enlarge the pool, although it is not a simple task.

To start, a Google form was designed, allowing applicants to upload their ticket details via the form for the project to crowdsource the data of different time and days when the GNIB office accepts applications. This creates its own problems. By replacing photos with an online data entry form, the physical correspondence between sources of data (pictures saved on computer) and the extracted information (e.g. applications already processed speed of the day) becomes uncertain. This raises considerable concerns over the validity of each data entry and the reliability of the information and ultimately the calculation of wait time. Thus, other mechanisms have to be in place and a Google spreadsheet was created to validate and process incoming data.

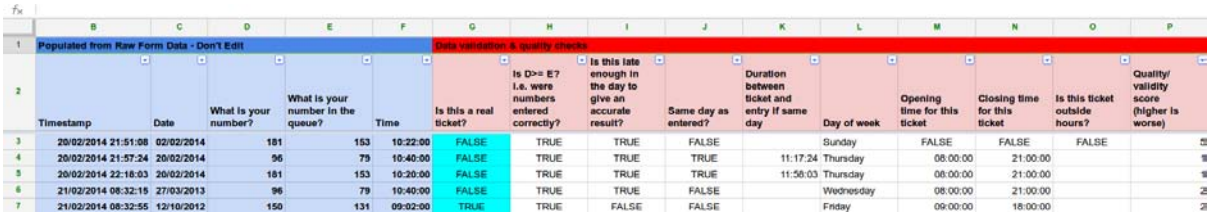
Indeed, a collection of ‘sheets’ needed to be created to turn raw social media and later volunteered data into useful data, before they can start to tell anything about the queue. Opening hours on different days of the week are kept in one sheet and the raw data gathered from pictures shared in social media in another. As partially captured in Figure 2, the main sheet, aptly entitled ‘calculations’, is a constellation of logical and arithmetic functions (in the red area in the figure) that seek to determine whether there are errors within the entry of a particular user, accidental or otherwise, and how to best use the extracted data for calculating wait time. For example, Column P takes into account all pieces of data extracted from individual tickets to assign a score to each row of data according to their quality for estimating queue time.

```
=if(B4="","",countif(G4:O4,FALSE))
```

Above is the function behind the column, which reviews several aspects of the ticket and the queue to evaluate the data. They include whether the numbers related to the queue are entered correctly; if a ticket is taken too early in the day to tell how the queue progress in that day; if the data are provided when the applicant is in the queue; or if the ticket is taken within the opening hours. Each of these aspects is transformed into a TRUE or FALSE statement in the columns

leading to Column P where a score is given by counting the number of FALSE between Column G and O to determine the data quality of each row.

Figure 2: Becoming useful data



	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Populated from Raw Form Data - Don't Edit					Data validation & quality checks									
2	Timestamp	Date	What is your number?	What is your number in the queue?	Time	Is this a real ticket?	Is D>= E? i.e. were numbers entered correctly?	Is this late enough in the day to give an accurate result?	Same day as entered?	Duration between ticket and entry if same day	Day of week	Opening time for this ticket	Closing time for this ticket	Is this ticket outside hours?	Quality/ validity score (higher is worse)
3	20/02/2014 21:51:08	02/02/2014	181	153	10:22:00	FALSE	TRUE	TRUE	FALSE		Sunday	FALSE	FALSE	FALSE	
4	20/02/2014 21:57:24	20/02/2014	96	79	10:40:00	FALSE	TRUE	TRUE	TRUE	11:17:24	Thursday	08:00:00	21:00:00		
5	20/02/2014 22:18:03	20/02/2014	181	153	10:20:00	FALSE	TRUE	TRUE	TRUE	11:58:03	Thursday	08:00:00	21:00:00		
6	21/02/2014 08:32:15	27/03/2013	96	79	10:40:00	FALSE	TRUE	TRUE	FALSE		Wednesday	08:00:00	21:00:00		
7	21/02/2014 08:32:55	12/10/2012	150	131	09:02:00	TRUE	TRUE	FALSE	FALSE		Friday	09:00:00	18:00:00		

These aspects of a ticket create various kinds of expectations regarding how valuable insights extracted from them can streamline the queue in the GNIB office. The ‘intelligence’ that can be extracted from a single ticket can tell if it is near real-time queue data; if someone is providing fake data; how the progress of a particular day compares with others; how the variation of processing speed affect wait time on that specific day, which days, hours or seasons are more congested than others; or how a particular ticket should be given more ‘weight’ in the process of estimating wait time. These expectations and the streamlining of the queuing problem also echo corporate discourses and the ‘smartmentality’ that transforms urban issues into algorithms and predictions of differing complexity (Vanolo, 2013).

The process of developing the spreadsheet reveals the ‘contextual effectiveness’ of the solution. That is, the solution is momentarily effective, contingent upon different kinds of contact that can be made because of the project and the endurance of such relationships in terms of withstanding continual, oncoming challenges. The spreadsheet became stablised as the solution when the project started, because the richest points of contact with the people affected by the queue came from social media. Other resources they started with were rather limited, including the lack of response from the police, leading the design of the spreadsheet towards validating self-provided data. Also, the project gained considerable traction among Code for Ireland participants because of various problems and promises that are at play when cities confront technologies, and vice versa. The process of extracting intelligence about the queue from very

limited sources of information is a tricky task and it is this trickiness that makes some participants tick. This motivation, however, has to be contextualised by the shared frustration of participants and the expectations and exploration of what they could do differently. At times, it is an exploration of 'marketing strategies' to encourage applicants in the GNIB office to upload their queue details, and in others, strategies for getting necessary data reconsidered by authorities. At these occasions, personal contacts with relevant departments are offered for initiating another discussion on the queuing problem and the project within the government, alongside suggestions regarding possible deployment of the solution at other public offices where the physical office and personnel might be more receptive. These different offerings are set in motion because of the shared distress, as well as the opportunity of participating in cracking open a small window to an enduring, widely encountered and yet neglected problem.

In addition to contextual effectiveness, the 'progress' of developing the solution cannot be separated from the friction occurring from the attempt of relocating technological artefacts into new sociomaterial arrangements of objects, social entities and activities (Barry, 2001). The solution to the queue in the GNIB office bears similarities with advanced capabilities of data analytics that often feature 'deep' understanding of the data and real-time adjustment of estimates according to continuous streams of data flows. However, the development of the capabilities of the analytics is different in practice. Starting out with the expectations to provide dynamically adjusted wait time estimation, the project has reduced in its scope, stripping them down to a simpler estimate of wait time and the opening hours and address of the immigration. This 'progress' arises from inviting the garda to discuss the solution with the project members.

At the meetup, the project members were divided into two groups: one listening to project updates and the other explaining the project idea to the garda. However, as the field note below shows, while sympathetic towards the project, the garda was not sure about the rationale behind the initiative. The idea behind the project is straightforward from the participants' perspective. But when the idea came into contact with the garda and his previous experience of community police work, it suddenly lost its attractiveness:

> When I joined, the garda was listening to the project explaining its motivation, but he looked a bit confused. It was suggested that helping build the app could benefit the police because this can reduce the amount of work the police needs to handle when people come

to ask for information or help. So he raised the point, from a community service's perspective, you would want people to come to talk to us.

Meeting with community members face-to-face is an important mechanism for them, as the garda further explained, because it fosters building up rapport between the police and the community. The burden from the project's perspective is actually an advantage that community policing seeks to establish. This mis-positioning of the project's expectation became a setback to the strategy of attracting the buy-in from the police.

At this point, the conversation continued, but with a slight change of focus that tried again to bring closer the alignment with the police to pursue the solution. This time, the emphasis was placed on exploring the possibility of setting up an automated process of collecting queuing data. This topic was discussed in both groups, one going through some technical possibilities and the other seeking comments from the garda, before the two groups merged to involve the whole project in the conversation. Since then, this topic grew into a recurrent theme, one that tried to conceptually hack into the IT system in the GNIB office but inevitably became the object of the hack of the organisational and technological complexity of the office. Throughout the discussion, many suggestions were provided. They asked if the agency keeps any record of the number of applications received on each day. However, the garda suspected that the ticket machine only does the issuing of tickets and is not connected to any application database. As a result, such records might not exist. This meant two different sets of tactics for the project. One is to convince the agency that granting the project access to the record, providing it exists, has real benefits to applicants and the agency alike. But this might be a long process before receiving a response. The other set of tactics involved coming up with different technical arrangements to extract data from the physical office, and these strategies, in their turn, excited and disappointed the participants.

The most exciting piece of information they uncovered was that the ticketing machine is a closed system and not connected to any application database. This was encouraging in the sense that, by only getting the numbers of applications received at the office, security threats and privacy concerns would become less serious an issue for the project since no personal data would be obtained, nor unintended and unauthorised access to immigration data would become possible due to the initiative. The project could obtain near real-time data about the flows of the incoming

applicants and prediction results could adapt to the change of the flows constantly. Various strategies were then proposed to take advantage of this discovery. One project member suggested a hardware hack that taps into the ticketing system to count and time the issuing of tickets. Another proposed that they install a camera in the office to stream the image of ticket numbers shown on the digital display in the office for optical character recognition. A supplementary comment pointed out the camera should be equipped with data exchange capability to send out the images. Inspired by the conversation, a fourth participant added that the camera could also show how crowded the office is in real-time, as well as the counters to see how many are taking applications and the rates of processing them.

The envisioning of new technical arrangements encountered more complications. The idea of installing a camera in the office triggered privacy concerns because applicants can be unwillingly captured by the camera. Indeed, the angle of the camera can be adjusted so that it only captures the image of the digital display and nothing else, as one participant revised the plan. But the receptiveness of the agency was largely unknown and difficult to anticipate due to the organisational, jurisdictional and spatial intermingling of the office. The GNIB office is shared and jointly controlled by the Department of Justice and the police. Installing a camera in the physical office would involve planning and negotiating with both agencies, understanding the sensitivity levels of the space, their respective ticketing systems, different roles and functions performed by the staff, and organisational willingness to collaborate or concerns over adopting a system which can be appropriated to evaluate efficiency. Even the details of the model and make of the ticketing machine or the digital display were difficult to obtain on the day, because it was a Saturday, outside of normal office hours when civic hacking events tend to happen. Furthermore, using existing infrastructure in the office would be most cost-effective to upload the captured image for subsequent processing, but the Internet connectivity in the office is integrated with the standalone security system for the police, and to apply to gain access to the infrastructure adds to another layer of difficulty were the strategy to be adopted.

After the discussion with the garda, the project members were far from convinced that crowdsourcing would be the most efficient strategy to acquire data, although this approach was firmed up as the strategy to pursue the project. It nonetheless comprises effective sociotechnical arrangements with which the project can gain traction among participants and mobilise their ideas and skills to develop the app, and a related website that aims to provide relevant

immigration information and communication contents to continue lobbying the agency. They also planned to put on stickers or flyers in the GNIB office to encourage queue ticket holders to upload their ticket details, as well as establishing partnerships with cafes and shops nearby to increase flyer exposure.

Furthermore, the process of working up the strategy of crowdsourcing data allows technologies to effect and change as a way of materialising the differences and syntheses of expectations associated with the individuals, initiatives and organisations that become involved in the project (Mackenzie, 2013). Crowdsourcing data as a strategy might not be the most innovative one, and it is developed under precarious sets of encounters and relationships. But it possesses instrumental value in that the calculated wait time starts to make sense after several attempts of marketing the project to people in the queue. It also generated symbolic value when the project received attention from the news and renewed interest from the GNIB office, although the real scope of cooperation remains uncertain. There still remains a gap between the instrumental and symbolic value, which provides a reminder of how government and everyday undertakings and urban problems are differently prioritised and materialised in the misalignment of expectations.

Conclusion

This paper has sketched out how solutions are worked up and become stablised and supported because of effective arrangements of various precarious relationships. Identifying and developing a solution involves a certain level of streamlining the problem. It has been argued that frictions are instrumental elements in the process of developing technologies to address urban problems. Understanding solutions in terms of the frictions a civic hacking project encounters and endures also highlights that the new sociotechnical arrangements developed to address an urban problem depend on the extent to which specific sets of relationships between participants, skills, expectations and technologies can be stabilised to support the initiative. Accordingly, developing a solution also requires a commitment to establishing the contextual effectiveness of a solution by relocating technologies, objects, skills, motivations and expectations. In the example of the Queuing App, photos of queuing tickets have to be worked into a spreadsheet and the spreadsheet has to accommodate the situation where only limited information can be extracted

from the ticket. Furthermore, expectations articulated by and associated with participants, relevant agencies, technologies and objects might align, contradict or have missed opportunities to connect. At the same time, these expectations can be situated in technical and organisational contexts that are too complex and entangled for a civic initiative to tackle in full. Such is the case with the Queuing App project. The initiative signals the problem, designs possible solutions, reveals the untidy spatial relationships within the GNIB office, and focuses on the aspect of the problem where the expectations of different entities can materialise into effective sociotechnical arrangements.

It is these practices, encounters and frictions, rather than simply the innovativeness and newness of artefacts and project ideas, that provide a start to engineering a social smart city. Recognising 'the incompleteness of cities' (Sassen, 2012) is a beginning of disclosing the interdependencies of a problem when solutions are designed to sensitise and respond to frictions emerging from relocating sociotechnical arrangements and expectations to solve the problem. Understanding civic hacking in terms of friction then foregrounds that its solutions are contingently stabilised in technological, motivational, spatiotemporal and organisational specificities, and that a progressive trajectory of development is far less important than articulating what are the people, skills, technological requirements, organisational cultures and frames and understandings of problems are enabled, particularised, marginalised, sidelined or excluded in the course of designing and mobilising specific solutions.

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